

A CRITICAL REVIEW OF THE MARINE NEMATODE GENUS *EUCHROMADORA* DE MAN, 1886

By JOHN W. COLES

SYNOPSIS

Seven species of *Euchromadora*, two of which are new, are described : *E. vulgaris* (Bastian, 1865) [type species] ; *E. adriatica* (v. Daday, 1901) ; *E. gaulica* Inglis, 1962 ; *E. loricata* (Steiner, 1916) ; *E. scampae* sp. nov. ; *E. shirleyae* sp. nov. and *E. striata* (Eberth, 1863). On the basis of their study a general account of the morphology of the genus is given and the genus diagnosed. *Euchromadora* is characterized chiefly by (1) the complicated structure of the cuticle, with transverse rows of large oval to hexagonal markings at the anterior end of the body which become elongate posteriorly ; and (2) the shape of the male genital apparatus, which supplies the most important characters in the delimitation of species. The remaining nominal species are reviewed and only eight are considered valid : *E. amokurae* (Ditlevsen, 1921) ; *E. archaica* Steiner and Hoeppli, 1926 ; *E. chitwoodi* nom. nov. [= *E. striata* of Chitwood, 1951] ; *E. inflatispiculum* Schuurmans Stekhoven, 1943 ; *E. mediterranea* Allgén, 1942 ; *E. parafricana* Gerlach, 1958 ; *E. permutabilis* Wieser, 1954 ; *E. tokiokai* Wieser, 1955. *E. tridentata* of Wieser, 1951 [nec Allgén, 1929] is considered a synonym of *E. gaulica* and *E. tyrrhenica* Brunetti, 1952 a synonym of *E. adriatica*. All nomenclatorial changes are listed on page 191.

INTRODUCTION

THE genus *Euchromadora*, which was erected by de Man in 1886 for *Chromadora vulgaris* Bastian, 1865, contains some of the largest members of the family Chromadoridae. Species are commonly found among the finer marine algae which constitute a major part of their food. De Man's diagnosis of the genus is based on his (1886) description of *E. vulgaris*, which is very detailed with magnificent figures, in marked contrast to the inadequacy of nearly all the descriptions published since then. In this diagnosis he stresses : (1) the very complex cuticle, (2) the form of the head with a movable dorsal tooth, (3) the gradual posterior swelling of the oesophagus which does not form a definite bulb, (4) the absence of pre-cloacal supplements in the male and (5) the unequal and dissimilar spicules, a character he particularly stresses. Some species now referred to *Euchromadora* were originally placed in the genus *Spilophora* Bastian, 1865 including *S. loricata* Steiner, 1916. However, soon after describing this species Steiner (1918), from a study of six species from the west coast of Africa, modifies the diagnosis of *Euchromadora*. He considers the genus should not be restricted by (3) and (5) above, i.e. the form of the oesophagus and the inequality of the spicules, because *Spilophora loricata*, although having a pronounced

posterior oesophageal bulb and equal spicules, is in all other respects a typical *Euchromadora*. He therefore expands the concept of *Euchromadora* to include this species. Filipjev in the same year (1918) independently reaches the same conclusion after studying specimens of *Odontobius striatus* Eberth, 1863, and refers this species to *Euchromadora*. More recently Wieser (1954) reviews the genus (with a key) in a successful attempt to bring some order to it.

I have studied specimens of seven species of *Euchromadora* from the coasts of the British Isles (all among algae); Spitzbergen; Banyuls-sur-Mer, France and from off the coast of South Africa, thus: *E. vulgaris* (Bastian, 1865); *E. adriatica* (v. Daday, 1901); *E. gaulica* Inglis, 1962; *E. loricata* (Steiner, 1916); *E. scampae* sp. nov.; *E. shirleyae* sp. nov. and *E. striata* (Eberth, 1863). These species are described below in detail and on the basis of the data so obtained the remaining species of the genus are reviewed.

MORPHOLOGY

General Form and Cuticle.

The general shape of the body which is illustrated in Text-fig. 22 (*E. gaulica*) appears to be a reflection of the structure of the cuticle as is suggested by Steiner and Hoeppli (1926). Superficially the dark amber cuticle appears to be marked by coarse transverse striations (in *E. vulgaris* such striations are about 3μ apart at the anterior end near the head, 4μ at the posterior end of the oesophagus, 5μ on the mid-body region and 4μ apart at the anal region). At the head end a few uneven rows of small circular punctations occur in the cuticle before the striations become apparent anteriorly. There is, however, some variation according to the degree of contraction or expansion of the head. Associated with the striations, posterior to the circular punctations, are the oval to hexagonal markings so very characteristic of the genus. Inglis (1964a), who has made a most detailed study of the cuticle of this genus, shows that the cuticle is composed of an external and an internal series of transverse rings which are joined together by a series of rods. The external rings are slightly anterior to the internal rings and are wedge-shaped in section. The thin edge of the wedge projects over the stoutly rounded posterior edge of the immediately preceding ring, on the anterior part of the body. On the posterior part of the body the conditions are reversed, and in the female this change takes place at the vulva. Projecting from the intermediate connecting rods are anteriorly-directed processes of dense material which, in plan view, are seen as the characteristic hexagonal markings. De Man (1886) figures these markings with lines connecting each row giving the appearance of a basket-work formation which, as Inglis (1964a) points out, is probably an optical illusion. It has already been shown that the various components of the cuticle are at different levels. In their study of *E. archaica* Steiner and Hoeppli (1926) consider that the significance of the hexagonal formations is for stiffening and adding strength to the cuticle, but Inglis refines this argument in terms of the conflicting demands of tangential stress and longitudinal flexibility.

Farther posteriorly, about the posterior end of the oesophagus, the hexagonal markings become increasingly elongate. On the lateral surfaces this condition

exists along the length of the body, while on the dorsal and ventral surfaces the markings become restricted to certain regions of the body. In most species, on the dorsal and ventral surfaces, commencing at the anterior region where the oesophagus narrows a little, two zones occur without hexagonal markings, and these widen very gradually till near the posterior end of the oesophagus (see Text-fig. 1). The markings between these two regions (i.e. on the mid-dorsal and mid-ventral surfaces) then become narrower and disappear over a tapering zone. This middle part is then devoid of markings until just beyond the cloaca or anus, when they reappear over a similar tapering zone to surround the body again in the tail region. However, in one species (*E. shirleyae*), the markings between the two clear zones, on the dorsal and ventral surfaces, continue throughout the length of the worm (see Text-fig. 8). In larval specimens no such differentiation occurs and the punctation markings are small and oval, lending support to Inglis' argument that the elaborations of the adult cuticle derive from a system of simple punctation rods and canals.

In some species other modifications are seen, deep within the cuticle, on the lateral surfaces. They have been referred to by Steiner (1918) and Micoletzky (1924) as 'articulation structures' and by Inglis (1962) as 'lateral plates'. They are seen in some specimens much more clearly than in others, and depending on the condition of the specimen and the observer, can be interpreted differently. Micoletzky (1924) notes that they form a kind of lateral membrane over about 30 per cent. of the diameter of the body and are probably formed with the last moult. These modifications occur on the inner solid transverse rings (? basal layer) which Inglis (1964a) describes. The centre portion of each 'plate', through which runs a minute pore, curves anteriorly on its anterior edge at the anterior end of the body, while on the posterior part of the body the conditions are reversed (see Text-fig. 6). In the female the change over takes place at the vulva. In some species such 'lateral plates' have not been seen at all, for example, in *E. archaica* according to Steiner and Hoeppli (1926). Instead these authors figure a series of curved lines on the lateral surfaces and I have noted that it is the same in *E. adriatica*.

Ocelli have been observed at the anterior end in some specimens of *E. vulgaris* and *E. striata*, but it appears that the pigment often dissolves out on preservation so that the ocelli become invisible. Body setae are usually present. In *E. vulgaris* and *E. striata* they occur at the anterior end of the body in four files of twelve to fifteen setae (corresponding approximately to the four cephalic setae) about 30 μ apart and extending to the level of the anterior end of the intestine. Posterior to this region in both these species setae occur only sporadically. However in all other species setae occur sporadically over the whole length of the body, including the oesophageal region. It is probable that they are frequently lost during collection, fixation and subsequent processing. There are nearly always two pairs of setae near the tip of the tail. One pair projecting dorsally and the other pair projecting ventrally (Text-fig. 3). The tail in both sexes is usually fairly long, but species differ a little in this respect. The usual three caudal glands are present, posterior to the anal region and a well marked spinneret is present.

Head structures.

The head is very blunt, a character, which in conjunction with the dark cuticle, is useful when sorting specimens under a dissecting microscope. The mouth opening is surrounded by a rather poorly defined cuticular sheath which is supported by the twelve rugae typical of the family. There are two circles of six head papillae, those of the inner circle are very small (not seen in the smaller species but most likely present) and those of the outer circle are prominent and setose. Farther posteriorly are four long cephalic setae dorso- and ventro-lateral in position, which are about 10μ to 15μ long. Laterally, at this same level, are the two crescent-shaped or slit-like amphids. The anterior end of the oesophagus forms a conical 'onchial cavity' (terminology of Inglis (1964)) at the anterior edge of which is a large dorsal tooth (onchium), together with subventral plates, denticles and other variable cuticular structures. The edges of the ventro-lateral sectors of the oesophagus are thickened at the base of the onchial cavity to form horizontal rod-like cuticular structures. These structures can only be seen with very great difficulty in *en face* view because, as lateral views establish, they lie slightly posterior to the dorsal onchium and the other structures developed on the ventro-lateral walls of the onchial cavity. The dorsal onchium belongs to what Wieser (1954) calls the 'solid type'. The whole of the mouth region (rugae, anterior end of the oesophagus) is flexible to enable the onchia to extrude and this causes the outline of the head to vary in different specimens.

Oesophagus and Intestine.

The oesophagus narrows a little behind the onchial cavity and in some species is provided with a well defined posterior bulb, in some it widens very gradually towards the posterior end, while in one, *E. shirleyae*, it is of almost even width throughout its length. The nerve ring is situated a little in front of half the length of the oesophagus and is not always easily seen. The excretory pore, which in some species is not seen, is situated just a little posterior to the nerve ring. A seta-like appendage about 2μ to 3μ long is situated at the mouth of the excretory pore in *E. vulgaris* and *E. striata* and at about 1.5 times the diameter of the head from the anterior end (ventrally) in *E. gaulica*. Cobb (1914) mentions the occurrence of this appendage in his description of *E. denticulata* and *E. meridiana* and Micoletzky (1924) also found it on his specimens of *E. striata* from Suez. The ventral gland, which usually extends to beyond the anterior end of the intestine, is seen more clearly in some species than in others.

Male.

The shape of the male genital apparatus, which is a characteristic feature of this genus, also supplies the most important characters for the recognition of species. The spicules are paired, usually equal in length and identical in structure (in the type-species, however, they are unequal). The gubernaculum consists of a pair of lateral, massive, cuticular, somewhat hammer-shaped, structures which are usually more prominent than the spicules, and a median dorsal piece which is triangular in outline. The single testis is outstretched and its junction with the vas deferens is

not clearly defined. Two median pre-cloacal setae are generally present (in one species they are replaced by papillae (see Text-fig. 8) but pre-cloacal sucker-like supplements typical of most genera of the family do not occur.

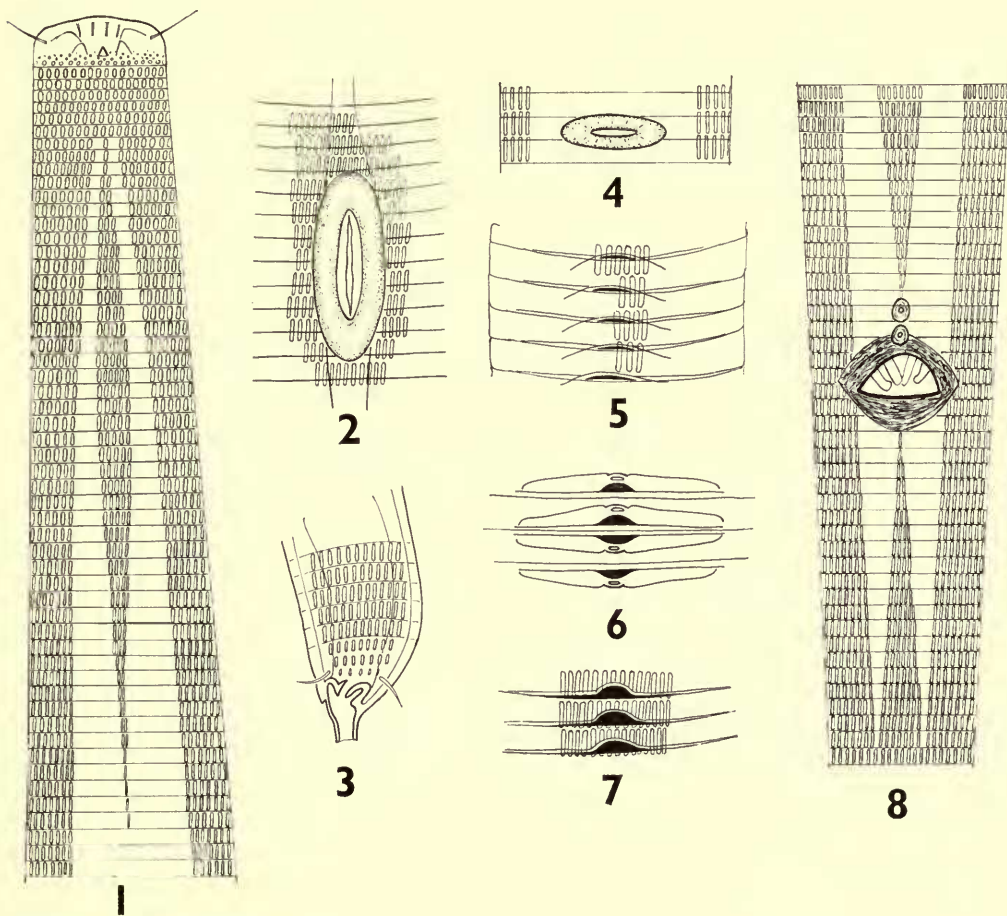


FIG. 1. Diagram of the anterior end of *Euchromadora* spp. to illustrate the arrangement of the cuticular markings on the dorsal and ventral surfaces. FIG. 2. Vulva of *E. shirleyae*. FIG. 3. Posterior extremity of *E. adriatica* (typical of all species studied). FIG. 4. Vulva of *E. vulgaris* (typical of all species studied except *E. shirleyae*). FIG. 5. *E. scampae*. Structures comparable to the 'lateral plates' just posterior to the oesophagus. FIG. 6. 'Lateral plates' at approximately the mid-body region of *E. vulgaris*, *E. striata*, *E. gaulica* and *E. loricata*. FIG. 7. *E. vulgaris*. 'lateral plates', cloacal region. FIG. 8. *E. shirleyae*. Ventral view of the cloacal region to illustrate the arrangement of the cuticular markings and the pre-cloacal papillae. (All Figs. except 2-4 semi-diagrammatic.)

Female.

The female reproductive system is double and the ovaries are opposed and reflexed. Usually about three to six eggs, which measure from about $35\mu \times 32\mu$ to about $90\mu \times 65\mu$, are present in the uteri. Up to nineteen have been seen in one species. The vulva is situated ventrally about the mid-point of the worm and in all the species I have examined, except one, it is a transverse slit relative to the longitudinal axis of the body (Text-fig. 4). In *E. shirleyae* the slit is longitudinal and relatively more prominent (see Text-fig. 2).

DIAGNOSIS OF THE GENUS

Euchromadora appears to be the culmination of an evolutionary trend through *Chromadorita* and *Neochromadora*, in which there is an increasing complexity of the head, spicules and gubernaculum and, particularly, the cuticle. The characteristic morphological features of the genus may be summarised in a diagnosis as follows :

Chromadoridae. Cuticle complicated with transverse rows of large oval to hexagonal markings at the anterior end of the body, which become elongate posteriorly ; onchial cavity with a large solid movable dorsal onchium and various dentate cuticular plates and other cuticular structures ; amphids large crescent-shaped slits.

MALE : Spicules equal or subequal, similar in structure ; gubernaculum present, consisting of prominent paired, somewhat hammer-shaped, lateral pieces and a dorsally situated median plate ; pre-cloacal supplements absent ; testis single and outstretched.

FEMALE : Ovaries paired, opposed, reflexed ; up to nineteen eggs in the uterus, but usually no more than six.

TYPE SPECIES : *Chromadora vulgaris* Bastian, 1865.

CHARACTERS OF IMPORTANCE IN THE DELIMITATION OF SPECIES

Wieser (1954) treats the genus in two groups. In one group the dorsal onchium is large with an enlarged base, and the distal portion is, in most cases, bent and directed anteriorly, and the onchial cavity is heavily sclerotized. In the other group the dorsal onchium is of medium size and not bent, while the onchial cavity is less sclerotized. It is clear that whether the dorsal onchium is pointing anteriorly or not is of no significance because this structure is movable and its position varies from specimen to specimen.

During this study other degrees of cuticularization of the onchial cavity have become apparent which suggest there is a series of forms of increasing complexity. Thus *E. scampae* is the simplest form studied and compares with Wieser's group ' B ' (Text-figs. 16-18), *E. shirleyae* is of intermediate complexity (Text-figs. 19-21), *E. loricata* and *E. adriatica* much more complicated and *E. vulgaris* and *E. striata* (Text-figs. 9-12) the most complicated forms of all. *E. gaulica* is almost as complicated as *E. vulgaris* and *E. striata* but is a smaller species. On the walls of the onchial cavity of these latter species are cuticular plates and rows of small denticles ; situated subventrally are two enlarged double-pointed cuticular plates anterior to the horizontal rod-like structures described on page 162. It would appear that what have frequently been referred to as subventral teeth are in fact these rod-like

structures. The enlarged plates are usually more difficult to see in lateral view than in *en face* preparations.

The punctation markings of the cuticle show slight variation in shape at the anterior end of the body ; in some species they are more markedly hexagonal, or even rectangular, than in others. This depends to a certain extent on the focusing as the shape varies a little at different levels, so that this character is of little value in delimiting species. Only one species, *E. shirleyae*, is markedly different from the others in lacking clear zones on the mid-dorsal and mid-ventral surfaces (see page 184).

The most valuable characters for the separation of species are the shape and relative lengths of the spicules, the shape of the gubernaculum, particularly the distal end, and the lengths of the lateral pieces of the gubernaculum relative to the length of the spicules. When only females are available exact determination is, in general, not possible.

***Euchromadora vulgaris* (Bastian, 1865) de Man, 1886**

(Text-figs. 9-12, 24-25)

Chromadora vulgaris Bastian, 1865. *Trans. Linn. Soc. Lond.* **25**, 167-168, pl. 13, figs. 233-235.

Euchromadora vulgaris, de Man, 1886. *Anatomische Untersuchungen über freilebende Nordsee-Nematoden*. Leipzig, 69-75, pls. 12-13.

TYPE LOCALITY : Falmouth, Cornwall, England.

MATERIAL STUDIED : Numerous specimens (12♂♂ 12♀♀, 4 larvae selected at random and measured) from : green or blue-green filamentous algal growth on the sea water circulation benches, Laboratory of the M.B.A., Plymouth, August, 1955 (B.M. (N.H.) Reg. Nos. 1955.11.1. 326-337) ; among *Cladophora rupestris* growing in a rock-pool fairly high on the shore, Wembury Bay, S. Devon, June, 1956 (Reg. Nos. 1963. 525-539) ; among algae, approx. M.L.W.N., Hannafore, Looe, Cornwall. June, 1956 (Reg. Nos. 1963. 540-554) ; among algae incl. *Corallina* sp., rockpool, Black Rock, Brighton, Sussex, August, 1960 (Reg. Nos. 1963. 555-561) ; among filamentous blue-green algae (incl. *Anabaena ? torulosa* and *Oscillatoria* sp.) in a rock pool high on the shore, Poyllbrein, south coast, Isle of Man, August, 1961 (Reg. Nos. 1963. 562-566) ; among *Enteromorpha* sp., Falmouth, Cornwall, August, 1960 (Reg. Nos. 1963. 567-570).

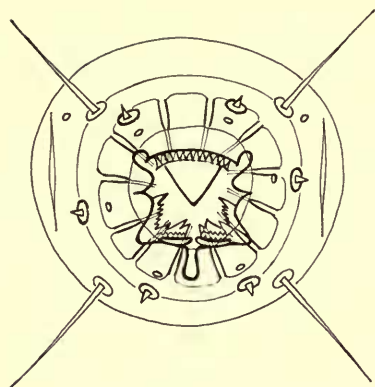
	Body length (mm.)	a	b	Body ratios c	length gubernaculum length spicules × 100
Males	1.85	30.8	5.1	9.7	61.5
	1.85	23.1	5.7	9.7	63.5
	1.85	23.1	5.7	9.7	66.7
	1.90	27.1	5.8	9.0	57.3
	1.92	27.4	5.4	9.8	61.7
	1.94	26.9	5.5	8.8	57.1
	2.10	23.3	6.1	10.5	62.8
	2.15	25.2	5.9	9.7	54.7
	2.17	21.7	6.4	9.0	60.9
	2.23	24.8	6.5	11.7	58.2
	2.27	28.3	5.9	11.3	61.4
	2.35	26.7	6.5	10.7	57.3

					V
Females	1·84	23·0	5·4	9·2	50·0
	1·97	21·9	5·8	8·6	47·7
	2·00	20·0	6·0	8·7	47·5
	2·15	20·5	5·6	8·7	49·3
	2·16	30·0	5·4	9·4	50·9
	2·20	18·3	5·8	8·9	48·2
	2·25	17·3	5·6	9·0	48·0
	2·37	21·2	5·4	8·6	50·2
	2·37	21·5	5·9	8·7	49·3
	2·50	20·8	6·6	9·4	48·0
	2·53	21·1	7·0	9·7	47·4
	2·55	23·2	6·4	9·5	50·9
Larvae	1·00	22·2	4·0	7·1	54·0
	1·02	22·6	4·2	7·3	—
	1·02	22·6	4·1	7·7	—
	1·37	22·4	5·1	9·1	—

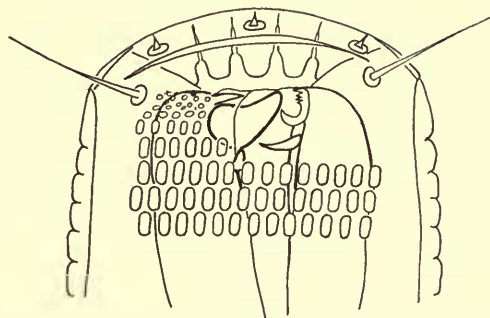
MEASUREMENTS (in mm. in order of body lengths). MALES. Body breadth: 0.060; 0.080; 0.080; 0.070; 0.070; 0.072; 0.090; 0.085; 0.100; 0.090; 0.080; 0.088. Head diameter: 0.032; 0.034; 0.034; 0.033; 0.034; 0.033; 0.040; 0.035; 0.034; 0.035; 0.034; 0.032. Length of oesophagus: 0.36; 0.32; 0.32; 0.36; 0.35; 0.35; 0.34; 0.36; 0.34; 0.34; 0.38; 0.36. Length of tail: 0.19; 0.19; 0.19; 0.21; 0.19; 0.22; 0.20; 0.22; 0.24; 0.19; 0.20; 0.22. Cloacal diameter: 0.050; 0.055; 0.056; —; 0.055; 0.055; 0.070; 0.060; 0.065; 0.067; 0.057; 0.055. Length of spicules: 0.065; 0.063; 0.063; 0.075; 0.060; 0.070; 0.070; 0.075; 0.069; 0.067; 0.070; 0.075. Length of gubernaculum (lateral pieces): 0.040; 0.040; 0.042; 0.043; 0.037; 0.040; 0.044; 0.041; 0.042; 0.039; 0.043; 0.043. Distance of nerve ring from anterior end: —; 0.152; 0.149; —; 0.150; —; —; 0.152; —; 0.130; 0.160; 0.143. Distance of excretory pore from anterior end: 0.155; —; 0.180; —; 0.165; —; —; 0.163; —; 0.159; 0.180; 0.175.

FEMALES. Body breadth: 0.080; 0.090; 0.100; 0.105; 0.072; 0.120; 0.130; 0.112; 0.110; 0.120; 0.120; 0.110. Head diameter: 0.034; 0.033; 0.035; 0.033; 0.036; 0.038; 0.040; 0.038; 0.037; 0.045; 0.036; 0.038. Length of oesophagus: 0.34; 0.34; 0.33; 0.38; 0.40; 0.38; 0.40; 0.44; 0.40; 0.38; 0.36; 0.40. Length of tail: 0.20; 0.23; 0.23; 0.25; 0.23; 0.24; 0.25; 0.27; 0.27; 0.26; 0.26; 0.27. Anal diameter: —; 0.041; 0.040; 0.044; 0.050; 0.050; 0.058; 0.055; 0.060; —; 0.050; 0.050. Distance of vulva from anterior end: 0.92; 0.94; 0.95; 1.06; 1.10; 1.06; 1.08; 1.19; 1.17; 1.20; 1.20; 1.30. Distance of nerve ring from anterior end: 0.150; —; —; 0.160; 0.163; —; 0.161; —; —; —; 0.140; —. Distance of excretory pore from anterior end: 0.165; —; 0.125; 0.180; —; —; 0.182; —; 0.180; —; 0.170; —.

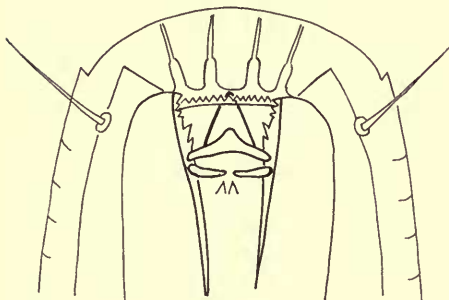
LARVAE. Body breadth: 0.045; 0.045; 0.045; 0.061. Head diameter: 0.030; 0.031; 0.032; 0.032. Length of oesophagus: 0.25; 0.24; 0.25; 0.27. Length of tail: 0.13; 0.14; 0.13; 0.15.



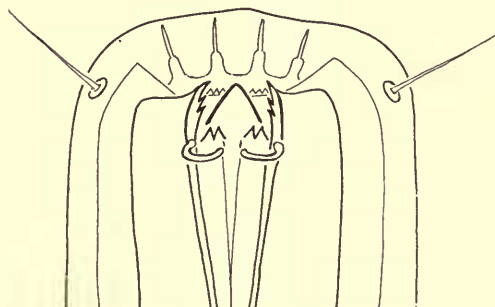
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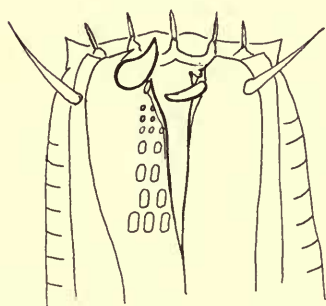
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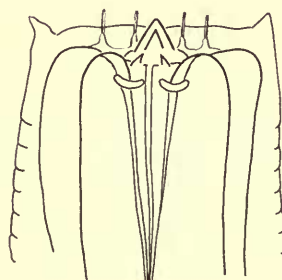
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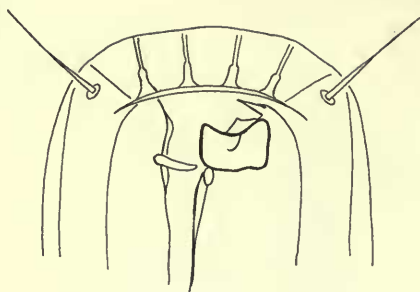
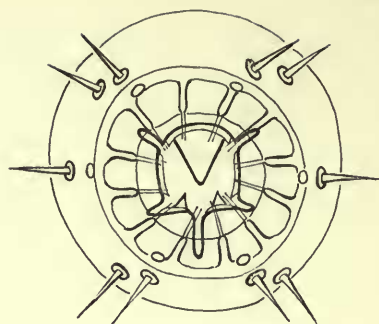
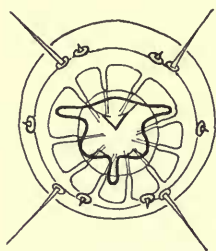
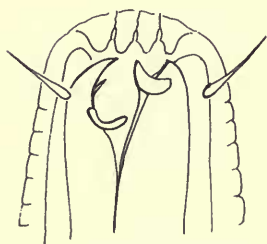
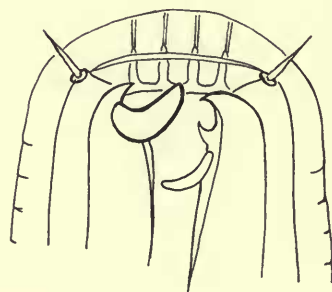
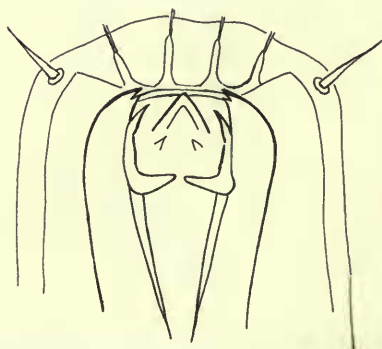


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FIGS. 9-12. *E. vulgaris*. Fig. 9 *En face* view of head. Fig. 10. Lateral view of head. Fig. 11. Dorsal view of head. Fig. 12. Ventral view of head. FIGS. 13-14. *E. gaulica*. Fig. 13. Lateral view of head. Fig. 14. Ventral view of head. (All to same scale.)

**15****19****16****17****20****18****21**

GEOGRAPHICAL DISTRIBUTION. NORWAY : Vega, Gasnes, Ingoy and Stappen etc. (Allgén, 1940, 1943, 1946, 1951a) ; SWEDEN : West coast, vicinity of the Zoological Station, Kristineberg (Allgén, 1929, 1929b, 1951, 1953). DENMARK : Limfjord and Kattegat (Ditlevsen, 1919) ; HOLLAND : Walcheren (de Man, 1886), coast of Zeeland (de Man, 1907, 1907a ; oyster-beds, Yerseke (Schuermans Stekhoven, 1942) GERMANY : Insel Amrum, Schleswig-Holstein etc. (Gerlach, 1953, 1954). FRANCE : Coast of Brittany (Ditlevsen, 1923). BRITISH ISLES : Falmouth (Bastian, 1865) ; Plymouth (Wieser, 1951, 1952) ; Whitstable (Maghraby and Perkins, 1956) ; Coast of southern England and Isle of Man (present author, see above) ; West coast of Ireland—Blacksod Bay, Clew Bay—shores of Clare I. and Annagh I. (Southern, 1914).

DISTINCTIVE CHARACTERS. Cuticle : ' Lateral plates ' present. Cephalic setae : 12 μ . Head and oesophagus : The onchial cavity is complicated, with cuticular plates and rows of denticles on the inside walls. Two enlarged double-pointed cuticular plates are situated subventrally, opposite the dorsal onchium (as described on page 164) (Text-figs. 9–12). The oesophagus widens gradually towards the posterior end, without forming a distinct bulb. The ventral gland is indistinct, extending to the posterior end of the oesophagus or to the anterior end of the intestine. A seta-like appendage is situated at the mouth of the excretory pore.

MALE : The spicules, which carry fine alae, are unequal in length but similar in shape. The smaller left spicule is about 85 per cent. of the length of the longer, i.e. by measuring the chord. The heavily cuticularized paired lateral pieces of the gubernaculum, which are equal in length and very prominent, have a characteristic shape with a denticle near the distal end. They are a little more than half the length of the longer spicule and the dorsally situated median plate of the gubernaculum is just a little longer than the lateral pieces (Text-figs. 24–25). In a larval male specimen (? 4th stage) the lateral pieces of the gubernaculum are of typical form, although the spicules are not fully developed.

FEMALE : Up to twelve eggs may be present in the uterus, their size varying from 90 μ $\times$ 65 μ —56 μ $\times$ 55 μ .

Discussion.

This species, which has not been described since de Man's paper (1886) has often been reported from the coasts of north west Europe where it appears to be very common. It has never been reported from the Mediterranean, and only Allgén has reported it from localities outside European waters. As is pointed out on page 185 only one of the seven new species described by Allgén can be considered valid and in view of the general uncertainty resulting from this assessment of his work it is better to consider the following records given by Allgén as doubtful : Falkland Is. (1959) ;

FIG. 15. *E. adriatica*. Lateral view of head. FIGS. 16–18 *E. scampae*. Fig. 16. *En face* view of head. Fig. 17. Lateral view of head. Fig. 18. Ventral view of head. FIGS. 19–21. *E. shirleyae*. Fig. 19. *En face* view of head. Fig. 20. Lateral view of head. Fig. 21. Ventral view of head. (All to same scale.)

Hilo, Pacific Ocean (1951b) ; Tobago, West Indies (1947) (1 ♀) ; Bay of Panama ; Perlas Is. ; Taboguilla ; La Jolla shore, California (1947a).

Euchromadora striata (Eberth, 1863) Filipjev, 1918
(Text-figs. 26-27)

Odontobius striatus Eberth, 1863. *Untersuchungen über Nematoden*. Leipzig. 30, pl. 1, figs. 21-27.

Euchromadora striata, Filipjev, 1918. *Trav. Lab. Zool. Sebastopol* 2 (4), 241-244, pl. 7, fig. 47 ; Micoletzky, 1924. *S. B. Akad. Wiss. Wien* 133, 155-157 ; Schuurmans Stekhoven, 1943. *Zool. Jb. (Syst. etc.)* 76, 364-365, figs. 33 A-D ; Brunetti, 1952. *Monit. zool. ital.* 59, 74-78, figs. 1 A, A¹, A², A³ ; Wieser, 1954. *Hydrobiologia* 6, 190-191, fig. 16.

nec *Euchromadora striata*, Chitwood, 1951. *Texas J. Sci.* 3, 632, figs. 5 H-I (see p. 186).

TYPE LOCALITY : Nice, S. France.

MATERIAL STUDIED : 12 ♂♂ and 10 ♀♀ from the following localities (all among algae) : Covean, St. Agnes, Isles of Scilly, Sept., 1958 ; Hannafore, Looe, Cornwall (amongst *Furcellaria fastigiata*), E.L.W.S., June, 1956 ; Littlehampton, Sussex, August, 1959 (algae washed up on the shore) ; Skippers Island, Essex, February, 1961 ; Banyuls-sur-Mer, S. France, May, 1961. (B.M. (N.H.) Reg. Nos. 1963. 571-582).

	Body length (mm.)	a	b	Body ratios	
				c	$\frac{\text{length gubernaculum}}{\text{length spicules}} \times 100$
Males	1.64	27.3	5.2	8.8	61.1
	1.77	25.3	5.0	8.7	51.8
	1.85	24.6	5.4	9.6	47.5
	2.00	24.7	5.6	8.3	55.9
	2.12	35.3	7.6	11.3	47.0
	2.16	28.8	5.7	9.8	43.5
	2.18	32.5	6.2	10.2	49.3
	2.20	23.9	5.8	11.0	53.5
	2.21	24.5	5.8	11.0	52.2
	2.23	27.9	5.9	10.1	54.9
	2.32	27.6	5.6	10.3	55.5
	2.64	31.0	6.4	11.7	48.9
					V
Females	1.97	24.6	5.5	8.5	50.7
	1.99	30.1	5.5	8.5	51.7
	2.26	25.1	5.9	9.5	50.4
	2.36	23.6	5.2	9.3	50.8
	2.52	22.9	6.3	9.0	49.6
	2.63	21.9	6.4	9.4	47.1
	2.76	22.1	6.2	8.9	50.0
	2.80	25.4	5.9	9.2	50.0
	2.90	26.3	6.9	11.6	48.3
	3.03	23.3	6.6	9.2	48.8

MEASUREMENTS (in mm. in order of body lengths). MALES. Body breadth : 0.060 ; 0.070 ; 0.075 ; 0.081 ; 0.060 ; 0.075 ; 0.067 ; 0.092 ; 0.090 ; 0.080 ; 0.084 ; 0.085. Head diameter : 0.030 ; 0.033 ; 0.030 ; 0.034 ; 0.033 ; 0.032 ; 0.030 ; 0.032 ; 0.032 ; 0.032 ; 0.033 ; 0.035. Length of oesophagus : 0.31 ; 0.35 ; 0.34 ; 0.36 ; 0.28 ; 0.38 ; 0.35 ; 0.38 ; 0.38 ; 0.38 ; 0.41 ; 0.41. Length of tail : 0.18 ; 0.20 ; 0.19 ; 0.24 ; 0.19 ; 0.22 ; 0.21 ; 0.20 ; 0.20 ; 0.22 ; 0.22 ; 0.22. Cloacal diameter : 0.044 ; 0.042 ; 0.051 ; 0.046 ; 0.042 ; 0.046 ; 0.040 ; 0.054 ; 0.055 ; 0.051 ; 0.054 ; 0.050. Length of spicules : 0.072 ; 0.085 ; 0.080 ; 0.084 ; 0.068 ; 0.085 ; 0.075 ; 0.086 ; 0.090 ; 0.082 ; 0.081 ; 0.092. Length of gubernaculum (lateral pieces) : 0.044 ; 0.044 ; 0.038 ; 0.047 ; 0.032 ; 0.037 ; 0.037 ; 0.046 ; 0.047 ; 0.045 ; 0.045 ; 0.045 ; 0.045.

FEMALES. Body breadth : 0.080 ; 0.066 ; 0.090 ; 0.100 ; 0.110 ; 0.120 ; 0.125 ; 0.110 ; 0.110 ; 0.130. Head diameter : 0.035 ; 0.036 ; 0.035 ; 0.038 ; 0.038 ; 0.037 ; 0.038 ; 0.040 ; 0.034 ; 0.038. Length of oesophagus : 0.36 ; 0.36 ; 0.38 ; 0.45 ; 0.40 ; 0.41 ; 0.44 ; 0.47 ; 0.42 ; 0.46. Length of tail : 0.23 ; 0.23 ; 0.24 ; 0.25 ; 0.28 ; 0.28 ; 0.31 ; 0.30 ; 0.25 ; 0.33. Anal diameter : 0.043 ; 0.043 ; 0.045 ; 0.050 ; 0.050 ; 0.050 ; 0.050 ; 0.050 ; 0.044 ; 0.050. Distance of vulva from anterior end : 1.00 ; 1.03 ; 1.14 ; 1.20 ; 1.25 ; 1.25 ; 1.38 ; 1.40 ; 1.40 ; 1.48. Distance of nerve ring from anterior end : 0.165 (in specimen of 2.52 body length) ; 0.185 (in specimen of 3.03 body length). Distance of excretory pore from anterior end : 0.190 (in specimen of 2.52 body length) ; 0.208 (in specimen of 3.03 body length).

GEOGRAPHICAL DISTRIBUTION. FRANCE : Nice (Eberth, 1863) ; Banyuls-sur-Mer (Allgén, 1942 and present author, see above). ITALY : Isle of Ischia (Micoletzky, 1924) ; Gulf of Naples (Micoletzky, 1924 ; Brunetti, 1952 ; Wieser, 1954a) ; Portovenere (Wieser, 1954a) ; Sampiera, Sicily (Wieser, 1954a). OTHER MEDITERRANEAN LOCALITIES : Adriatic Sea (Micoletzky, 1924) ; Alexandria (Schuurman Stekhoven, 1943) ; Sea of Marmara (Prinkipo) (Micoletzky, 1924 ; Allgén, 1941) ; Black Sea (Sevastopol) (Filipjev, 1918) ; Suez (Micoletzky, 1924). South and east coast of ENGLAND ; Scilly Is. (present author, see above).

DISTINCTIVE CHARACTERS. Cuticle : 'Lateral plates' present. Cephalic setae : 12 μ —15 μ . Head and oesophagus : As in *E. vulgaris*.

MALE : The spicules are equal in length and identical in structure and in lateral view are quite stout. Eberth (1863), Filipjev (1918) and Brunetti (1952) figure this condition but Wieser (1954a) figures slender spicules. Some of the male specimens I have studied give the impression of slender spicules but, on closer examination, a weakly cuticularized ventral side could always be seen. Sometimes the appearance of slender spicules may be due to the angle from which they are studied. The lateral pieces of the gubernaculum are about half the length of the spicules and are of simpler form than those of *E. vulgaris* with no distinct denticle present near the distal end. This region, because it is a little ridged or thickened, sometimes gives the impression of a denticle. The proximal end does not widen as in *E. vulgaris* and is less prominent (Text-figs. 26 and 27).

FEMALE : Nineteen eggs have been seen in one specimen, but usually there are only about six in the uterus. Their size varies from about $50\mu \times 42\mu$ — $88\mu \times 50\mu$.

DISCUSSION. This species is very similar to *E. vulgaris*, but differs most decisively in the form of the spicules and gubernaculum. The most important character is the shape and length of the spicules. The length of the gubernaculum in proportion to the length of the spicules is usually about half, but sometimes a little greater.

E. striata has been reported frequently from the Mediterranean where it is probably very common. From my specimens it also appears to be common on the south coast of England, although not so common as *E. vulgaris* and *E. gaulica*. The two specimens (1♂ and 1♀ near together) found in a sample of algae from the Essex coast (Skippers Island) are the most northerly record for this species.

De Man (1886) recognizes that this species is similar to *E. vulgaris*, but without specimens he was unable to add anything to Eberth's description. In spite of Allgén (1942) Bastian (1865) did not report its occurrence on the coast of England, he merely repeats Eberth's diagnosis. As de Man (1886) mentions, Bastian did not recognize the similarity of *Odontobius striatus* to *Chromadora vulgaris*.

The description of *E. striata* by Chitwood (1951) from Aransas Bay, Texas is certainly not this species, but is closer to *E. gaulica*. The spicules, however, appear to be a little stouter than those of *E. gaulica*, according to Chitwood's figure, and the cephalic setae are shorter. It almost certainly represents a distinct species as will be dealt with later (see page 186).

Euchromadora gaulica Inglis, 1962

(Text-figs. 13–14, 22, 28–29)

Euchromadora gaulica Inglis, 1962. *Bull. Brit. Mus. (nat. Hist.) (Zool.)* **8** (5), 260–264, figs. 41–51 (♂♂ only, the ♀♀ belong to *E. striata* (Eberth, 1863)).

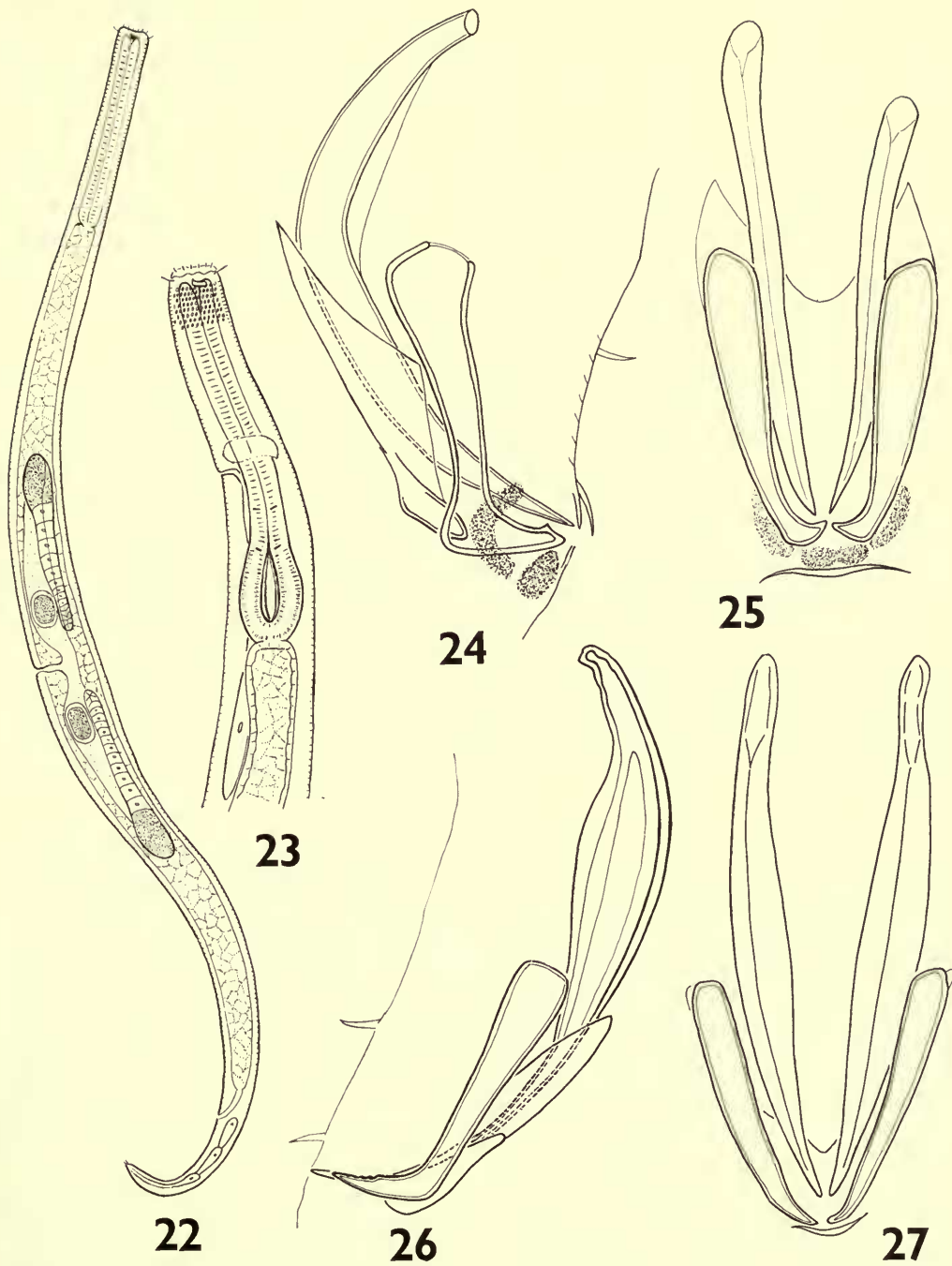
? *Euchromadora africana*, Schuurmans Stekhoven, 1950 (nec v. Linstow, 1908). *Mem. Inst. Sci. nat. Belg.* (2 ième Ser.) **37**, 137–138, figs. 81 A–D.

Euchromadora tridentata, Wieser, 1951 (nec Allgén, 1929). *Öst. zool. Z.* **3**, 455–456, figs. 6 a–c, e.

TYPE LOCALITY : Banyuls-sur-Mer, France.

MATERIAL STUDIED : Numerous specimens (12 ♂♂, 12 ♀♀, 4 larvae selected at random and measured). All among algae from the following localities : Croyde Bay, N. Devon (approx. M.L.W.S.), August, 1955 (the algae includes *Pelvetia canaliculata* unattached in a rock pool (B.M. Reg. Nos. 1956.8.16. 71–85) ; Wembury Bay, S. Devon (–0.2 ft. C.D.), June 1956 (Reg. Nos. 1963. 583–592) ; Littlehampton, Sussex (in algae washed up on the shore), August, 1959 (Reg. Nos. 1963. 593–595) ; Labrador Rock, near Teignmouth, S. Devon (in a fairly deep rock pool), July, 1961 (Reg. Nos. 1963. 596–600) ; Sprey Point, near Teignmouth, July, 1961 (Reg. Nos. 1963. 611) ; Black Rock, Brighton, Sussex, June 1961 (Reg. No. 1963. 612) ; Banyuls-sur-Mer, S. France, May, 1961 (Reg. No. 1964. 152).

FIG. 22. *E. gaulica*. Showing the typical body form of the genus. FIG. 23. *E. adriatica*. Anterior end of body. FIGS. 24–25. *E. vulgaris*. Fig. 24. Lateral view of spicules and gubernaculum. Fig. 25. Ventral view of spicules and gubernaculum. FIGS. 26–27. *E. striata*. Fig. 26. Lateral view of spicules and gubernaculum. Fig. 27. Ventral view of spicules and gubernaculum. (24–27 to same scale.)



	Body length (mm.)	<i>a</i>	<i>b</i>	Body ratios <i>c</i>	length gubernaculum length spicules $\times 100$
Males	1.18	31.1	5.6	7.9	61.4
	1.30	22.4	6.2	8.7	62.5
	1.42	29.5	6.0	8.3	55.1
	1.43	28.6	6.5	8.9	63.6
	1.44	28.8	6.8	8.5	57.8
	1.51	30.2	6.5	9.4	52.2
	1.53	27.8	6.9	9.0	63.8
	1.55	31.0	6.7	10.3	60.0
	1.60	26.7	6.1	9.4	61.7
	1.63	29.6	6.9	9.6	60.0
	1.67	30.4	6.9	9.8	64.0
	1.75	22.7	6.7	9.2	62.9
					V
Females	1.50	30.0	6.0	7.5	48.6
	1.53	25.5	6.4	8.0	49.7
	1.58	26.3	6.6	7.5	48.7
	1.65	28.9	6.1	8.7	50.9
	1.66	29.1	6.4	8.3	50.6
	1.72	24.5	6.6	7.8	49.4
	1.72	24.6	6.9	7.8	47.6
	1.74	20.4	6.7	8.7	49.4
	1.75	25.7	6.4	9.2	49.7
	1.75	25.0	6.5	7.9	48.5
	1.75	22.7	6.4	8.7	49.1
	1.77	24.5	6.8	7.7	48.6
Larvae	0.56	17.5	4.0	7.0	—
	0.76	20.5	4.5	6.3	—
	0.82	25.6	4.5	5.8	—
	0.83	20.7	4.6	6.4	48.2

MEASUREMENTS (in mm. in order of body lengths). MALES. Body breadth : 0.038; 0.058; 0.048; 0.050; 0.050; 0.050; 0.055; 0.050; 0.060; 0.055; 0.055; 0.077. Head diameter : 0.023; 0.025; 0.023; 0.022; 0.020; 0.020; 0.022; 0.023; 0.024; 0.022; 0.025; 0.026. Length of oesophagus : 0.21; 0.21; 0.22; 0.22; 0.21; 0.23; 0.22; 0.23; 0.26; 0.22; 0.24; 0.26. Length of tail : 0.15; 0.15; 0.17; 0.16; 0.17; 0.16; 0.17; 0.15; 0.17; 0.17; 0.17; 0.19. Cloacal diameter : 0.032; 0.040; 0.032; 0.030; 0.030; 0.030; 0.035; 0.030; 0.036; 0.030; 0.035; 0.037. Length of spicules : 0.044; 0.048; 0.049; 0.044; 0.045; 0.046; 0.047; 0.050; 0.047; 0.050; 0.050; 0.054. Length of gubernaculum (lateral pieces) : 0.027; 0.030; 0.027; 0.028; 0.026; 0.024; 0.030; 0.030; 0.029; 0.030; 0.032; 0.034.

FEMALES. Body breadth : 0.050; 0.060; 0.060; 0.057; 0.057; 0.070; 0.070; 0.085; 0.068; 0.070; 0.077; 0.072. Head diameter : 0.025; 0.025; 0.025; 0.027; 0.025; 0.025; 0.025; 0.025; 0.025; 0.025; 0.025. Length of oesophagus : 0.25; 0.24; 0.24; 0.27; 0.26; 0.26; 0.25; 0.26;

0.27 ; 0.27 ; 0.27 ; 0.26. Length of tail : 0.20 ; 0.19 ; 0.21 ; 0.19 ; 0.20 ; 0.22 ; 0.22 ; 0.20 ; 0.19 ; 0.22 ; 0.20 ; 0.23. Anal diameter ; 0.035 ; 0.030 ; 0.032 ; 0.028 ; 0.031 ; 0.035 ; 0.032 ; 0.035 ; 0.032 ; 0.031 ; 0.033 ; 0.031. Distance of vulva from anterior end : 0.73 ; 0.76 ; 0.77 ; 0.84 ; 0.84 ; 0.85 ; 0.82 ; 0.86 ; 0.87 ; 0.85 ; 0.86 ; 0.86.

LARVAE. Body breadth : 0.032 ; 0.037 ; 0.032 ; 0.040. Head diameter : 0.022 ; 0.021 ; 0.022 ; 0.024. Length of oesophagus : 0.14 ; 0.17 ; 0.18 ; 0.18. Length of tail : 0.08 ; 0.12 ; 0.14 ; 0.13. Anal diameter : 0.022 ; 0.028 ; 0.028 ; 0.026.

Nerve ring observed in larva of body length 0.76 mm.–0.080 mm. from anterior end.

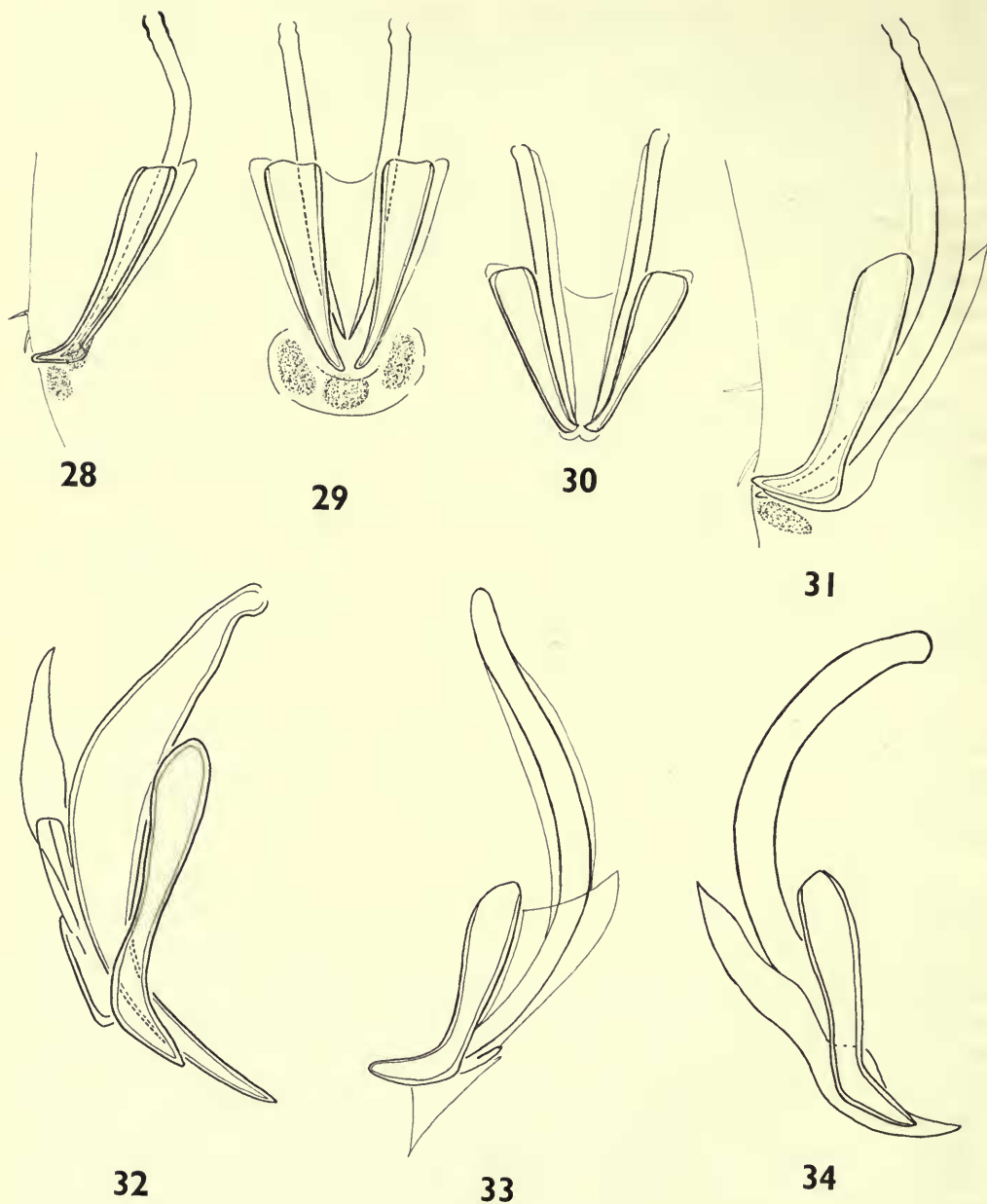
GEOGRAPHICAL DISTRIBUTION. MEDITERRANEAN SEA : Banyuls-sur-Mer (Inglis, 1962 and present author) ; Villefranche (Schuermans Stekhoven, 1950). Coast of ENGLAND : Plymouth (Wieser, 1951, 1952) ; N. and S. coasts of Devon ; Brighton and Littlehampton, Sussex (present author, see above).

DISTINCTIVE CHARACTERS. Cuticle : 'Lateral plates' present. Cephalic setae : 10 μ –12 μ . Head and oesophagus : Similar to *E. vulgaris* and *E. striata* but smaller (Text-figs. 13 and 14). Excretory pore not seen, but a seta-like appendage is situated ventrally about 1.5 times the diameter of the head from the anterior end. Ventral gland large, situated at the anterior end of the intestine.

MALE : The spicules are slender, equal in length and identical in structure with a distinctive elbow-shaped curve towards the proximal end which is more marked in some specimens than in others. No tooth-like projection has been observed on the distal ends of the lateral pieces of the gubernaculum, which are more than half the length of the spicules (Text-figs. 28 and 29).

FEMALE: Up to five eggs have been seen at a time in the uterus. They vary in size from 35 μ $\times$ 32 μ –50 μ $\times$ 45 μ .

DISCUSSION. This species is similar to *E. vulgaris* and *E. striata* in the general form of the body and in the cuticularization of the onchial cavity, but is smaller and differs most decisively from the two former species in the form of the male genital apparatus. It is sometimes found in the same clump of algae with *E. striata*, which makes the separation of the females difficult. However, on the basis of size it appears possible to separate them. In mature female specimens (with eggs) of *E. gaulica* the head diameter does not exceed 27 μ and the total length of the body is always less than 2 mm., while in mature females of *E. striata* the diameter of the head is always greater than 30 μ and the total body length usually exceeds 2 mm. This separation of the two species is supported by the sample from Croyde Bay in which numerous specimens of *E. gaulica* (determined by males) are present, but no *E. striata* ; and of all those measured (gravid specimens) the female diameter never exceeds 27 μ . This conclusion seems to be justified since the sexes are equally represented in large samples of species of *Euchromadora*.



FIGS. 28-29. *E. gaulica*. Fig. 28. Lateral view of spicules and gubernaculum. Fig. 29. Ventral view of spicules and gubernaculum. FIGS. 30-31. *E. adriatica*. Fig. 30. Ventral view of spicules and gubernaculum. Fig. 31. Lateral view of spicules and gubernaculum. FIG. 32. *E. loricata*. Lateral view of spicules and gubernaculum. FIG. 33. *E. scampae*. Lateral view of spicules and gubernaculum. FIG. 34. *E. shirleyae*. Lateral view of spicules and gubernaculum. (All to same scale, except Fig. 30.)

Inglis (1962) describes both males and females of *E. gaulica* but *E. striata* has since been found in the same locality (from a sample collected from almost the same locality) and as the diameter of the head of the females of *E. gaulica* examined by Inglis exceed 30μ it seems probable that his females really belong to *E. striata*.

Schuermans Stekhoven's (1950) description of *E. africana* v. Linstow, 1908 from Villefranche is probably of *E. gaulica*, but there has been some confusion concerning the status of the former species. The original description of *E. africana* by v. Linstow (1908) is based on one female specimen from off the coast of south west Africa and the only thing that can be established from it with certainty is that it is a species of *Euchromadora*. Steiner (1918) redescribes what he considers to be this species (including ♂♂) from the west coast of Africa and states that the lateral pieces of the gubernaculum are half the length of the spicules, but does not figure nor give dimensions for the spicules and gubernaculum. Schuermans Stekhoven (1950) also states the gubernaculum is half the length of the spicules based on his specimens from the Mediterranean (but in his figure the gubernaculum appears to be more than half the length of the spicules). On the basis of this Wieser (1954, 1955) uses the proportion gubernaculum half the length of the spicules, in conjunction with the total length of the spicules, as a key character for *E. africana*. However, it seems likely that v. Linstow, Steiner and Schuermans Stekhoven were all dealing with different species and since none are described satisfactorily, I agree with Inglis (1962) that *E. africana* and all its records must be considered those of species dubiae.

From my studies of *E. gaulica*, where the length of the gubernaculum in proportion to the length of the spicules can vary from 52 to 65 per cent, it is clear that the use of this proportion must be applied with caution in separating species. The shape of the spicules and gubernaculum is much more important and useful, and where these structures are not figured or are figured inaccurately much confusion is likely to be caused.

Wieser (1951) describes what he considers to be *E. tridentata* Allgén, 1929 from Plymouth. He figures the spicules and gubernaculum and uses the fact that the gubernaculum is two-thirds the length of the spicules as a means of differentiating it from *E. striata* (where the gubernaculum is half the length of the spicules). The original description of *E. tridentata* Allgén, 1929 is based on only one immature specimen and could represent any similar form of *Euchromadora*. Wieser's specimens from Plymouth undoubtedly belong to *E. gaulica*.

E. tokiokai Wieser, 1955 from Japan is very similar to *E. gaulica* but the gubernaculum appears to be relatively longer. Although Wieser in his table gives its length as 66 per cent the length of the spicules, by his measurements and from his illustration it is about 75 per cent the length of the spicules. Also the tail of both sexes is shorter than in *E. gaulica*.

***Euchromadora adriatica* (v. Daday, 1901) Brunetti, 1952**
(Text-figs. 3, 15, 23, 30-31)

Spilophora adriatica v. Daday, 1901. *Természeti. Füzet.* **24**, 447-449, pl. 22, figs. 10-14, pl. 23, fig. 1.

Euchromadora adriatica, Brunetti, 1952. *Monit. zool. ital.* **59**, 80.

Euchromadora tyrrhenica Brunetti, 1952. *Monit. zool. ital.* **59**, 73, 79–80, figs. 1 B, B¹, B².

Euchromadora tyrrenica, Inglis, 1962. *Bull. Brit. Mus. nat. Hist. (Zool.)* **8** (5), 264–266, figs. 52–56. (lapsus pro *tyrrhenica*.)

TYPE LOCALITY : Fiume, coast of Jugoslavia (Adriatic Sea).

MATERIAL STUDIED : 1 ♀ from Croyde Bay, N. Devon, August, 1955. (Brit. Mus. (N.H.) Reg. No. 1963. 606) ; 1 ♂ from a rock-pool, Labrador Rock, near Teignmouth, S. Devon, July, 1961 (Reg. No. 1963. 607) ; 2 ♂♂, 1 ♀ from a rock-pool (amongst *Cladophora* sp.), Wembury Bay, S. Devon, July, 1962 (Reg. Nos. 1963. 608–610). (All specimens were associated with algae.)

	Body length (mm.)	<i>a</i>	<i>b</i>	Body ratios <i>c</i>	length gubernaculum
					length spicules × 100
Males	1.24	22.5	5.4	8.8	63.1
	1.33	22.2	5.8	7.9	55.4
	1.73	19.6	6.8	8.6	60.8
					V
Females	1.70	17.0	5.7	8.9	48.2
	1.60	24.2	5.9	8.4	48.7

MEASUREMENTS (in mm. in order of body lengths). MALES. Body breadth: 0.055 ; 0.060 ; 0.088. Head diameter : 0.030 ; 0.028 ; 0.030. Length of oesophagus : 0.23 ; 0.23 ; 0.25. Length of tail : 0.14 ; 0.17 ; 0.19. Cloacal diameter : 0.035 ; 0.041 ; 0.058. Length of spicules ; 0.057 ; 0.065 ; 0.074. Length of gubernaculum (lateral pieces) : 0.036 ; 0.036 ; 0.045. Distance of nerve ring from anterior end : — ; 0.100 ; 0.115. Distance of excretory pore from anterior end : 0.115 ; 0.120 ; 0.135.

FEMALES. Body Breadth : 0.100 ; 0.066. Head diameter : 0.030 ; 0.031. Length of oesophagus : 0.30 ; 0.27. Length of Tail : 0.19 ; 0.19. Anal diameter : 0.057 ; 0.045. Distance of vulva from anterior end : 0.82 ; 0.78. Distance of nerve ring from anterior end : 0.130 ; 0.115. Distance of excretory pore from anterior end : 0.152 ; 0.135.

GEOGRAPHICAL DISTRIBUTION. ADRIATIC SEA : Fiume, coast of Jugoslavia (v. Daday, 1901) ; Rovinj, Istrien, Jugoslavia (Wieser, 1960). MEDITERRANEAN SEA : Gulf of Naples (Brunetti, 1952) ; Banyuls-sur-Mer (Inglis, 1962). ENGLAND : North and south coasts of Devon (present author, see above).

DISTINCTIVE CHARACTERS. Cuticle : 'Lateral plates' not seen in this species. Cephalic setae 10μ. Head and oesophagus : The dorsal onchium is more rectangular in outline than in any other species (Text-fig. 15). The double pointed enlarged subventral plates are not seen in this species. The oesophagus has a well defined posterior bulb and the excretory pore and ventral gland are fairly prominent (Text-fig. 23).

MALE : The spicules and gubernaculum are very similar to those of *E. gaulica*, but are somewhat longer and the spicules carry fine alae which are rather difficult to see and can be easily overlooked. The lateral pieces of the gubernaculum are about 60 per cent of the length of the spicules (Text-figs. 30 and 31).

FEMALE : Up to five eggs have been seen in the uterus. They measure $50\mu \times 40\mu$.

DISCUSSION. Micoletzky (1924) underrates the description of *Spilophora adriatica* by v.Daday (as in many other cases), stating that the posterior bulb of the oesophagus is shown too large. v.Daday's description and figures are adequate for the recognition of this species and, although he does not give the dimensions of the spicules, their length can be deduced fairly accurately from his figures, and they compare well with my specimens.

Brunetti (1952) recognizes *E. adriatica* but describes a very similar species (*E. tyrrhenica*) from the Tyrrhenian Sea. Since the descriptions of *E. tyrrhenica* by Brunetti (1952) and by Inglis (1962) do not differ from *E. adriatica* in any significant way, I consider *E. tyrrhenica* to be a synonym of *E. adriatica*. Dr. Inglis agrees with this synonymy.

Euchromadora loricata (Steiner, 1916) Steiner, 1918
(Text-fig. 32)

Spilophora loricata Steiner, 1916. *Zool. Jb. (Syst. etc.)* **39**, 526-532, pl. 19. figs. 3 a-n.

Euchromadora loricata, Steiner, 1918. *Zool. Anz.* **50**, 7.

nec *Euchromadora loricata*, Wieser, 1954. *Acta Univ. lund. N.F.* **50** (16), 104, figs. 152 a-b
(=*E. archaica* Steiner & Hoeppli, 1926).

TYPE LOCALITY : Barents Sea.

MATERIAL STUDIED. 5 ♂♂, 3 ♀♀ from a sample of brown filamentous algae (*Chordaria flagelliformis*) from the coast of Spitzbergen, 1954 (B.M. (N.H.) Reg. Nos. 1963 601-605). More specimens were in the sample but in too poor condition to be of any use.

	Body length (mm.)	<i>a</i>	<i>b</i>	Body ratios <i>c</i>	length gubernaculum
					length spicules × 100
Males	1.22	27.1	5.5	9.4	56.1
	1.23	28.6	5.8	10.2	61.8
	1.51	32.1	6.0	10.1	60.0
	1.62	32.4	6.0	10.1	61.8
	1.72	31.8	6.4	11.4	60.0
V					
Females	1.17	23.4	4.9	8.3	53.8
	1.50	25.0	6.2	9.4	50.0
	2.67	17.8	9.9	9.2	46.6

MEASUREMENTS (in mm. in order of body length). MALES. Body breadth : 0.045 ; 0.043 ; 0.047 ; 0.050 ; 0.054. Head diameter : 0.026 ; 0.025 ; 0.028 ; 0.027 ; 0.031. Length of oesophagus : 0.22 ; 0.21 ; 0.25 ; 0.27 ; 0.27. Length

of tail : 0.13 ; 0.12 ; 0.15 ; 0.16 ; 0.15. Cloacal diameter : 0.045 ; 0.040 ; 0.047 ; 0.050 ; 0.054. Length of spicules : 0.066 ; 0.055 ; 0.070 ; 0.068 ; 0.070. Length of gubernaculum (lateral pieces) : 0.037 ; 0.034 ; 0.042 ; 0.042 ; 0.042. Distance of nerve ring from anterior end : 0.141 (in specimen of 1.23 body length). Distance of excretory pore from anterior end : 0.150 (in specimen of 1.23 body length).

FEMALES. Body breadth : 0.050 ; 0.060 ; 0.150. Head diameter : 0.028 ; 0.030 ; 0.030. Length of oesophagus : 0.24 ; 0.24 ; 0.27. Length of tail : 0.14 ; 0.16 ; 0.29. Anal diameter : 0.040 ; 0.048 ; 0.050. Distance of vulva from anterior end : 0.63 ; 0.75 ; 1.25. Distance of nerve ring from anterior end : 0.100 ; 0.110 ; 0.120. Distance of excretory pore from anterior end : 0.120 ; — ; 0.148.

GEOGRAPHICAL DISTRIBUTION. Barents Sea (Steiner, 1916) ; Coast of Spitzbergen (present author, see above).

DISTINCTIVE CHARACTERS. Cuticle : 'Lateral plates' present. Cephalic setae : 11 μ —13 μ . Head and oesophagus : Similar to *E. adriatica*, oesophagus with a distinct posterior bulb ; excretory pore and ventral gland quite prominent.

MALE : The spicules are fairly stout and without alae. The lateral pieces of the gubernaculum are more than half the length of the spicules (Text-fig. 32).

FEMALE : Two eggs seen in one large specimen, measuring 50 μ $\times$ 35 μ .

DISCUSSION. Although only a few of the specimens from Spitzbergen are in good condition, they compare well with Steiner's original description. This species differs from *E. adriatica* chiefly in the form of the spicules, which are stout in comparison and without alae. Other differences are the occurrence of 'lateral plates' in the cuticle and the length of the cephalic setae, which are a little longer in this species.

Wieser's (1954) description of *E. loricata* from Chile does not refer to this species, but is similar to *E. archaica* Steiner and Høepli, 1926.

Allgén reports *E. loricata* from the west coast of Sweden (1951, 1953) but, as Wieser (1954) points out, these specimens do not have a definite posterior bulb to the oesophagus and the species cannot be recognised by the shape of the tail alone as Allgén claims. For this reason the following reports by Allgén must also be considered very doubtful : La Jolla, California (1947a) ; Bay of Panama (1951b) ; Port Jackson, Australia (1951b) ; Tasmania (1927) ; Hilo, Pacific Ocean (1951b) ; South Georgia (1959).

Euchromadora scampae sp. nov.

(Text-figs. 16–18, 33)

TYPE LOCALITY : Croyde Bay, N. Devon.

MATERIAL STUDIED : 12 ♂♂, 7 ♀♀, 3 larvae from the following localities (all among algae): Croyde Bay, N. Devon (among *Pelvetia canaliculata* and other algae unattached in a rock-pool, approx. M.L.W.S.), August, 1955 (B.M. (N.H.) Reg. Nos.

1963. 622-625 (No. 624 selected as holotype) ; Putsborough, nr. Woolacombe, N. Devon, August, 1955 (Reg. Nos. 1963. 626-627) ; Poyllbrein, south coast, Isle of Man (approx. M.L.W.S.), August, 1961 (Reg. Nos. 1963. 613-621) ; Wembury Bay, S. Devon (among *Cladophora* sp.), July, 1962 (Reg. Nos. 1963, 628-629).

	Body length (mm.)	<i>a</i>	<i>b</i>	Body ratios <i>c</i>	length gubernaculum length spicules $\times 100$
Males	1.32	34.7	6.0	8.2	54.5
	1.60	35.5	5.9	8.4	48.4 (Holotype)
	1.67	37.9	6.2	9.3	54.0
	1.73	38.4	7.4	7.5	50.0
	1.75	38.9	7.5	9.7	60.0
	1.76	39.1	7.8	10.0	56.6
	1.78	33.6	7.0	8.9	53.3
	1.78	34.2	7.7	9.6	45.2
	1.90	38.0	7.6	—	53.6
	1.90	38.0	8.2	10.5	55.2
	1.96	34.4	7.3	10.3	52.4
	2.04	35.8	7.5	9.3	63.1
Females	1.57	39.2	6.0	7.2	49.0
	1.63	37.9	6.4	7.7	—
	1.90	36.5	—	8.6	49.5
	1.91	32.9	7.1	8.5	49.7
	1.98	27.5	7.6	8.4	48.5
	2.01	28.7	7.4	8.0	51.2
	2.07	29.6	7.7	9.8	50.2
	2.07	29.6	7.7	9.8	50.2
Larvae	0.64	21.3	4.0	6.7	(? 1st or 2nd stage)
	0.84	28.0	4.2	6.8	(? 2nd stage)
	1.00	31.2	4.8	6.6	(? 3rd stage)

MEASUREMENTS (in mm. in order of body lengths). MALES. Body breadth : 0.038 ; 0.045 ; 0.044 ; 0.045 ; 0.045 ; 0.045 ; 0.053 ; 0.052 ; 0.050 ; 0.050 ; 0.057 ; 0.057. Head diameter : 0.020 ; 0.022 ; 0.021 ; 0.023 ; 0.020 ; 0.025 ; 0.020 ; 0.021 ; 0.021 ; 0.019 ; 0.020 ; 0.021. Length of oesophagus : 0.22 ; 0.27 ; 0.27 ; 0.23 ; 0.23 ; 0.22 ; 0.25 ; 0.23 ; 0.25 ; 0.23 ; 0.27 ; 0.27. Length of tail : 0.16 ; 0.19 ; 0.18 ; 0.23 ; 0.18 ; 0.17 ; 0.20 ; 0.18 ; — ; 0.18 ; 0.19 ; 0.22. Cloacal diameter : 0.036 ; 0.045 ; 0.040 ; 0.045 ; 0.040 ; 0.045 ; 0.045 ; 0.047 ; 0.045 ; 0.046 ; 0.050 ; 0.050. Length of spicules : 0.055 ; 0.062 ; 0.050 ; 0.060 ; 0.050 ; 0.053 ; 0.060 ; 0.062 ; 0.056 ; 0.058 ; 0.057 ; 0.057. Length of gubernaculum (lateral pieces) : 0.030 ; 0.030 ; 0.027 ; 0.030 ; 0.030 ; 0.030 ; 0.032 ; 0.028 ; 0.030 ; 0.032 ; 0.030 ; 0.036. Distance of nerve ring from anterior end : 0.085 in specimen of 1.75 body length ; 0.112 in specimen of 1.96 body length. Distance of excretory pore from anterior end : 0.115 in specimen of 1.96 body length.

FEMALES. Body breadth : 0.040 ; 0.043 ; 0.052 ; 0.058 ; 0.072 ; 0.070 ; 0.070. Head diameter : 0.021 ; 0.022 ; 0.021 ; 0.020 ; 0.021 ; 0.022 ; 0.022. Length

of oesophagus : 0.26 ; 0.25 ; — ; 0.27 ; 0.26 ; 0.27 ; 0.27. Length of tail : 0.22 ; 0.21 ; 0.22 ; 0.22 ; 0.23 ; 0.25 ; 0.21. Anal diameter : 0.035 ; 0.030 ; 0.030 ; 0.032 ; 0.035 ; 0.042 ; 0.035. Distance of vulva from anterior end : 0.77 ; — ; 0.94 ; 0.95 ; 0.96 ; 1.03 ; 1.04.

LARVAE. Body breadth : 0.030 ; 0.030 ; 0.032. Head diameter : 0.020 ; 0.020 ; 0.022. Length of oesophagus : 0.16 ; 0.19 ; 0.21. Length of tail : 0.096 ; 0.124 ; 0.152. Anal diameter : 0.024 ; 0.025 ; 0.025.

GEOGRAPHICAL DISTRIBUTION. Coasts of North and South Devon ; Isle of Man (present author, see above).

DISTINCTIVE CHARACTERS. Cuticle : The punctation markings at the anterior end are oval shaped and only a little smaller than the remaining rows of hexagonal markings which commence just posterior to the onchial cavity. Structures comparable to the 'lateral plates' occur as shown in Text-fig. 5, not always distinct. Cephalic setae : 8 μ . Head and oesophagus : The dorsal onchium is fairly small and the onchial cavity is simple with two simple, tooth-like projections, situated subventrally (Text-figs. 16–18). The oesophagus broadens very gradually towards the posterior end which is without a distinct bulb. The excretory pore and ventral gland are indistinct.

MALE : The spicules are bow-shaped and alate, equal in length and identical in structure. The lateral pieces of the gubernaculum are very similar in shape to those of *E. gaulica* and are only a little more than half the length of the spicules. The two pre-cloacal setae are very small and not easily seen (Text-fig. 33).

FEMALE : Up to six eggs at a time seen in the uterus. Their size varying from 50 μ $\times$ 30 μ –55 μ $\times$ 35 μ .

DISCUSSION. This species is most like *E. amokurae* and *E. mediterranea* in the simple form of the head, but differs from the first in lacking a posterior bulb to the oesophagus and in not having a knob-like swelling on the proximal end of the spicules. It differs from the second, *E. mediterranea*, in which the spicules which are longer and lack alae, and the gubernaculum is relatively smaller in *E. scampae*.

***Euchromadora shirleyae* sp. nov.**

(Text-figs. 2, 8, 19–21, 34)

TYPE LOCALITY : Off the coast of South Africa.

MATERIAL STUDIED : Numerous specimens (12 ♂♂, 12 ♀♀, 2 larvae selected at random and measured) from coarse white sand at a depth of 27 metres, 32° 02' S./18° 17' E. on 2.7.61. (University of Capetown Ecological Survey Reference No. WCD.91. (B.M. (N.H.) Reg. Nos. 1963. 939–1,060). Ref. No. WCD.99 (Reg. Nos. 1963. 1,061–1,072.)

	Body length (mm.)	<i>a</i>	<i>b</i>	Body ratios <i>c</i>	length gubernaculum length spicules × 100
Males	3.12	52.0	8.2	12.0	56.2
	3.20	53.3	7.4	12.3	58.3
	3.20	49.2	8.4	11.8	49.1
	3.25	46.4	7.7	13.0	55.9
	3.29	49.8	7.8	12.2	62.1
	3.35	51.5	7.9	11.9	57.1
	3.40	48.6	8.5	13.1	58.5
	3.50	56.4	7.8	12.5	53.7
	3.54	54.5	9.6	13.1	55.9
	3.85	53.5	8.2	12.0	58.8
	4.05	57.8	9.0	11.9	56.2 (Holotype)
	4.12	56.4	8.6	12.5	58.5
Females					V
	3.02	37.7	7.5	9.1	46.3
	3.15	42.0	7.7	8.7	47.6
	3.15	37.9	7.5	9.5	47.6
	3.20	45.7	7.1	7.4	46.9
	3.20	42.7	8.0	8.6	46.9
	3.32	38.2	6.9	8.3	45.8
	3.38	38.4	7.5	9.6	47.3
	3.48	41.9	7.4	8.3	43.4
	3.50	38.9	7.4	8.5	48.6
	3.62	44.7	7.5	8.6	46.9
	3.63	45.4	7.6	9.3	46.8
	3.80	47.5	7.9	9.5	47.4
Larvae	1.68	37.3	5.6	9.3	(larval ♂, gubernaculum seen)
	2.25	44.1	6.0	9.8	(? 4th stage ♂)

MEASUREMENTS (in mm. in order of body lengths). MALES. Body breadth : 0.060 ; 0.060 ; 0.065 ; 0.070 ; 0.066 ; 0.065 ; 0.070 ; 0.062 ; 0.065 ; 0.072 ; 0.070 ; 0.073. Head diameter : 0.027 ; 0.029 ; 0.027 ; 0.028 ; 0.028 ; 0.027 ; 0.028 ; 0.028 ; 0.028 ; 0.030 ; 0.030 ; 0.030. Length of oesophagus : 0.38 ; 0.43 ; 0.38 ; 0.42 ; 0.42 ; 0.42 ; 0.40 ; 0.45 ; 0.37 ; 0.47 ; 0.45 ; 0.45. Length of tail : 0.26 ; 0.26 ; 0.27 ; 0.25 ; 0.27 ; 0.28 ; 0.26 ; 0.28 ; 0.27 ; 0.32 ; 0.34 ; 0.33. Cloacal diameter : 0.060 ; 0.060 ; 0.055 ; 0.062 ; 0.056 ; 0.060 ; 0.060 ; 0.060 ; 0.060 ; 0.065 ; 0.070 ; 0.065 ; 0.068. Length of spicules : 0.064 ; 0.060 ; 0.057 ; 0.068 ; 0.066 ; 0.070 ; 0.065 ; 0.067 ; 0.068 ; 0.068 ; 0.073 ; 0.065. Length of gubernaculum (lateral pieces) : 0.036 ; 0.035 ; 0.028 ; 0.038 ; 0.041 ; 0.040 ; 0.038 ; 0.036 ; 0.038 ; 0.040 ; 0.041 ; 0.038.

FEMALES. Body breadth.: 0.080 ; 0.075 ; 0.083 ; 0.070 ; 0.075 ; 0.087 ; 0.088 ; 0.083 ; 0.090 ; 0.081 ; 0.080 ; 0.080. Head diameter : 0.030 ; 0.026 ; 0.027 ; 0.030 ; 0.028 ; 0.030 ; 0.027 ; 0.030 ; 0.030 ; 0.029 ; 0.030 ; 0.030. Length of oesophagus : 0.40 ; 0.41 ; 0.42 ; 0.45 ; 0.40 ; 0.48 ; 0.45 ; 0.47 ;

0.47 ; 0.48 ; 0.48 ; 0.48. Length of tail : 0.33 ; 0.36 ; 0.33 ; 0.43 ; 0.37 ; 0.40 ; 0.35 ; 0.42 ; 0.41 ; 0.42 ; 0.39 ; 0.40. Anal diameter : 0.045 ; 0.047 ; 0.050 ; 0.049 ; 0.050 ; 0.050 ; 0.050 ; 0.050 ; 0.050 ; 0.050 ; 0.050 ; 0.050. Distance of vulva from anterior end : 1.40 ; 1.50 ; 1.50 ; 1.50 ; 1.50 ; 1.52 ; 1.60 ; 1.50 ; 1.50 ; 1.70 ; 1.70 ; 1.80.

LARVAE. Body breadth : 0.045 ; 0.051. Head diameter : 0.026 ; 0.026. Length of oesophagus : 0.30 ; 0.37. Length of tail : 0.18 ; 0.23. Anal diameter : 0.040 ; 0.048.

GEOGRAPHICAL DISTRIBUTION. Coast of South Africa. (Present author.)

DISTINCTIVE CHARACTERS. Cuticle : The punctation markings are always hexagonal to rectangular in shape and not oval. The arrangement of the markings on the dorsal and ventral surfaces is unique. The hexagonal markings between the two clear zones (as described on page 161) continue throughout the length of the worm. However, on the ventral surface they become narrower in the region of the cloaca or anus (see Text-fig. 8). 'Lateral plates' not seen. Body setae absent, but this may be due (as explained on page 161) to the method of fixation. Cephalic setae : 6μ – 7μ . Head and oesophagus : The inner circle of six labial papillae is typical but the intermediate circle of sense organs is modified as setae, which are about the same length as the four cephalic setae, i.e. 6μ – 7μ (Text-fig. 19). The dorsal onchium is fairly large, but the onchial cavity is weakly sclerotized compared with the other larger species, and two simple ventro-lateral onchia are present (see Text-figs. 19–21). The nerve ring is difficult to see and the excretory pore and ventral gland have not been seen.

MALE : The spicules are equal in length and identical in structure, bow-shaped and non-alate. The gubernaculum is usually a little more than half their length (Text-fig. 34). There are no pre-cloacal setae as there are in all the other species studied by me. Instead there are two papillae (Text-fig. 8), which can only be seen in ventral view, in the same position. These are of quite different form from the sucker-like supplements (which can usually be seen easily in a lateral view) commonly found on other Chromadoridae.

FEMALE : The vulva is a relatively prominent longitudinal slit, in contrast to the transverse slit in other species (Text-figs. 2 and 4). No eggs have been seen.

DISCUSSION. This species differs from all the others in a number of ways, particularly in the form and arrangement of the cephalic papillae, the punctations of the cuticle, the shape of the vulva and the long slim body. All the other species studied are littoral forms while *E. shirleyae* is from much deeper waters.

REVIEW OF THE REMAINING SPECIES

Currently the genus *Euchromadora* contains twenty eight nominal species of which I accept only fifteen, seven of which are described above. This assessment is based largely on the form of the oesophagus and the male genital apparatus in conjunction

with the general body form. Although the structure of the head does supply useful additional characters the inadequate nature of most of the available descriptions makes their use impossible.

Of seven species described by Allgén only one can be considered valid, because of his very inadequate descriptions and poor figures. It is unlikely that specimens belonging to these nominal species could ever be recognized. For this reason most of the geographical records of Allgén must be considered doubtful, especially as he reports the occurrence of some European species in the southern hemisphere. As Wieser (1954) points out it is not possible to differentiate species by the shape of the tail as Allgén claims. Some of the earlier inadequate descriptions, although by reliable workers, are due to an insufficient understanding of the characters important in differentiating species. Thus, Steiner (1918), for example, describes six species from the west coast of Africa which cannot be recognized as he does not figure, nor give dimensions of, the spicules and gubernaculum, although males were present in most cases.

***Euchromadora africana* v. Linstow, 1908 species dubia**

Euchromadora africana v. Linstow, 1908. *Denkschr. Med. nat. Ges. Jena* **13**, 28, pl. IV, figs. 20-21.

?*Euchromadora africana*, Steiner, 1918. *Zool. Anz.* **50**, 8-10, fig. 1.

nec *Euchromadora africana* of Schuurmans Stekhoven, 1950 (= ? *E. gaulica* Inglis, 1962).

TYPE LOCALITY : Luederitzbucht, South West Africa.

GEOGRAPHICAL DISTRIBUTION. Coast of South West Africa (v. Linstow, 1908) ; Lome, Togo, west coast of Africa ; Teneriffa (Steiner, 1918).

The status of this species is discussed on page 177 where it is regarded as a species dubia.

***Euchromadora amokurae* (Ditlevsen, 1921) Allgén, 1929**

Spilophora amokurae Ditlevsen, 1921. *Vidensk. Medd. naturh. Foren. Kbh.* **73**, 16-17, fig. 11, pl. I, fig. 6, pl. II, figs. 4, 5 ; Allgén, 1928. *Nyt. Mag. for Naturw.* **66**, 251-253, figs. 1 a-b

Euchromadora amokurae, Allgén, 1929. *Zool. Anz.* **84**, 137-140 ; Wieser, 1954. *Acta Univ. lund. N.F.* **50** (16), 105-106, figs. 154 a-g.

TYPE LOCALITY : Auckland I., North arm of Carnley harbour.

GEOGRAPHICAL DISTRIBUTION. Auckland I. (Ditlevsen, 1921) ; Campbell I. (Allgén, 1928) ; Macquarie I. (Allgén, 1929a) ; I. de los Estados (Staten I.) off Tierra del Fuego (Allgén, 1930, 1959) ; Cape Brett, New Zealand (Ditlevsen, 1930) ; San Pedro, California (Allgén, 1947a) ; Honolulu ; Zamboanga, Philippine Is. ; Port Jackson, Australia ; Bay of Panama ; La Jolla shore, California (Allgén, 1951b) ; Chile (Gerlach, 1953a) (Wieser, 1954) ; Falkland Is. ; South Georgia ; Graham Land (Allgén, 1959). Japan (Wieser, 1955).

This species, which is similar to *E. scampae* in the form of the head, appears to be common in the southern hemisphere. It is characterized by a knob-like swelling at the proximal end of the spicules, and the oesophagus has a posterior bulb.

***Euchromadora archaica* Steiner and Hoeppli, 1926**

Euchromadora archaica Steiner & Hoeppli, 1926. *Arch. Schiffs. Tropenhyg.* **30**, 558-565, 571-573, figs. L-P.

Euchromadora loricata of Wieser, 1954. *Acta Univ. lund.* N.F. **50** (16), 104, figs. 152 a-b. (nec Steiner, 1916.)

TYPE LOCALITY : Shore of Joshi Island, near Kobe, Japan.

GEOGRAPHICAL DISTRIBUTION. Joshi I., Japan (Steiner and Hoeppli, 1926) ; Coast of Chile (Wieser, 1954).

This species which has a well defined posterior oesophageal bulb is similar to *E. adriatica*, but is a larger form. It is also similar to *E. loricata* (Steiner, 1916), but differs from it chiefly in the form of the spicules, which are slender, and in the absence of 'lateral plates'. This latter character is particularly stressed by Steiner and Hoeppli.

***Euchromadora chitwoodi* nom. nov.**

Euchromadora striata of Chitwood, 1951. *Texas J. Sci.* **3**, 632, figs. 5 H-I. (nec Eberth, 1863.)

TYPE LOCALITY: Mud Island, Aransas Bay, Texas.

GEOGRAPHICAL DISTRIBUTION. Aransas Bay, Texas (Chitwood, 1951).

This species is similar to *E. gaulica*, but the spicules are a little stouter, the gubernaculum is about half the length of the spicules and the cephalic setae are shorter. See further discussion under *E. striata* (page 172).

***Euchromadora denticulata* Cobb, 1914 species dubia**

Euchromadora denticulata Cobb, 1914. *Contr. Sci. Nematology* **1**, 8, 1 fig.

TYPE LOCALITY : Cape Royds, Antarctic.

GEOGRAPHICAL DISTRIBUTION. Cape Royds, Antarctic (Cobb, 1914).

Because no males were present and the description is insufficient I consider this to be a species dubia.

***Euchromadora dubia* Steiner, 1918 species dubia**

Euchromadora dubia Steiner, 1918. *Zool. Anz.* **50**, 10-11, fig. 2.

TYPE LOCALITY : Luederitzbucht, coast of South West Africa.

GEOGRAPHICAL DISTRIBUTION. Luederitzbucht, coast of South West Africa Steiner, 1918).

This species, which has fairly long cephalic setae and a posterior bulb to the oesophagus, is unlikely to be recognized, as the male genital apparatus is not figured nor are dimensions given for these structures. It is therefore treated as a species dubia.

Euchromadora elegans Allgén, 1947 species dubia

Euchromadora elegans Allgén, 1947. *Vidensk. Medd. naturh. Foren.* **110**, 159-160, figs. 56 a-c.

TYPE LOCALITY : La Jolla shore, California.

GEOGRAPHICAL DISTRIBUTION. Coast of California (Allgén, 1947a).

In spite of an adequate number of specimens (incl. 18 ♂♂) the resulting description is so very poor that it can only be treated as that of a species dubia.

Euchromadora eumeca Steiner, 1918 species dubia

Euchromadora eumeca Steiner, 1918. *Zool. Anz.* **50**, 14-15, fig. 5.

TYPE LOCALITY : Porto Seguro, Senegal.

GEOGRAPHICAL DISTRIBUTION. Senegal, West Africa (Steiner, 1918).

There is no adequate description of the male genital apparatus and as a result this form is unlikely to be recognized and is better treated as a species dubia.

Euchromadora hupferi Steiner, 1918. species inquirenda

Euchromadora (Odontocricus) hupferi Steiner, 1918. *Zool. Anz.* **50**, 13-14, fig. 4.

TYPE LOCALITY : Gorée in Senegal.

GEOGRAPHICAL DISTRIBUTION. Senegal, West Africa (Steiner, 1918).

As the markings on the cuticle of this species are quite different to those of all other species of *Euchromadora*, Steiner referred it to a new subgenus *Odontocricus*, which Filipjev (1934) apparently regards as a distinct genus. Since the description is poor and inadequate ; without illustrations of the male genital apparatus or head and only a sketch of the general appearance of the cuticle ; this species will be treated as a species inquirenda since we can hope the characteristic cuticular pattern will enable it to be recognized in future.

Euchromadora inflatispiculum Schuurmans Stekhoven, 1943

Euchromadora inflatispiculum Schuurmans Stekhoven, 1943. *Zool. Jb. (Syst. etc.)* **76**, 365-366, figs. 34 A-D ; 1950. *Mem. Inst. Sci. nat. Belg.* (2 ième Ser.) **37**, 139, figs. 82 A-D.

TYPE LOCALITY : Villefranche, Mediterranean Sea.

GEOGRAPHICAL DISTRIBUTION. MEDITERRANEAN SEA : Villefranche ; Alexandria (Schuurmans Stekhoven, 1943, 1950).

This species is very characteristic in lacking lateral pieces to the gubernaculum and by the shape of the slender spicules which are swollen at their distal ends. Schuurmans Stekhoven's illustration in the 1950 description shows the spicules as being much shorter than the one given in his 1943 paper. The onchial cavity appears to be of intermediate complexity. Until more specimens are found nothing more can be added to the rather unsatisfactory descriptions by Schuurmans Stekhoven.

Euchromadora kryptospiculum (Allgén, 1942) Allgén, 1951 species dubia*Spilophora kryptospiculum* Allgén, 1942. *Zool. Jb. (Syst. etc.)* **76**, 49-50, figs. 11 a-c.*Euchromadora kryptospiculum*, Allgén, 1951. *Vidensk. Medd. naturh. Foren. Kbh.* **113**, 390-391, figs. 54 a-c.

TYPE LOCALITY : Banyuls-sur-Mer, S. France.

GEOGRAPHICAL DISTRIBUTION. MEDITERRANEAN SEA: Banyuls-sur-Mer (Allgén, 1942). CALIFORNIA : La Jolla shore, (Allgén, 1951b).

This species is very poorly described and, as Wieser (1954) has pointed out, the two descriptions of Allgén most probably represent different forms. From the figures of the male it seems that the spicules and gubernaculum are not fully developed, and that Allgén has been dealing with immature forms. This species must be treated as a species dubia.

Euchromadora linstowi Allgén, 1959 species dubia*Euchromadora linstowi* Allgén, 1959. *Freeliving Nematodes. Further Zoological Results of the Swedish Antarctic Expedition 1901-1903*, Stockholm, 137-138.*Euchromadora* sp. v. Linstow, 1892. *Mitt. naturh. Mus. Hamburg* **9**, 65.

TYPE LOCALITY : South Georgia.

GEOGRAPHICAL DISTRIBUTION. South Georgia (v. Linstow, 1892 ; Allgén, 1959) ; Falkland Islands (Allgén, 1959).

As the description of this species is, like all the descriptions in this publication, inadequate it must be treated as a species dubia.

Euchromadora lüderitzi Steiner, 1918 species dubia*Euchromadora lüderitzi* Steiner, 1918. *Zool. Anz.* **50**, 12-13, fig. 3.

TYPE LOCALITY : Lüderitzbucht, South West Africa.

GEOGRAPHICAL DISTRIBUTION. Coast of South West Africa (Steiner, 1918).

Although males are present Steiner does not figure nor give dimensions of the spicules and gubernaculum. As this species is unlikely to be recognized it must be treated as a species dubia.

Euchromadora mediterranea Allgén, 1942*Euchromadora mediterranea* Allgén, 1942. *Zool. Jb. (Syst. etc.)* **76**, 51-52, figs. 12 a-c ; Wieser, 1954. *Hydrobiologia* **6**, 189-190, figs. 15 a-c.

TYPE LOCALITY : Banyuls-sur-Mer, S. France.

GEOGRAPHICAL DISTRIBUTION. MEDITERRANEAN SEA: Banyuls-sur-Mer (Allgén, 1942) ; Italy : Portovenere ; Sorrento, Gulf of Naples (Wieser, 1954a).

This species, which is very similar to *E. scampae* in the form of the head, is characterized by slender spicules and the large, very prominent lateral pieces of the guber-

naculum, which are quite stout and whose extremities (especially the proximal ends) are more rounded than in *E. scampae*.

***Euchromadora meridiana* Cobb, 1914 species dubia**

Euchromadora meridiana Cobb, 1914. *Contr. Sci. Nematology* **1**, 8, 9, 28, 1 fig.

TYPE LOCALITY : Cape Royds, Antarctic.

GEOGRAPHICAL DISTRIBUTION. Cape Royds, Antarctic (Cobb, 1914).

The description of this species is so inadequate that it is unlikely to be recognized and is best treated as a species dubia.

***Euchromadora mortenseni* (Allgén, 1947) Wieser, 1954 species dubia**

Spilophora mortenseni Allgén, 1947. *Vidensk. Medd. naturh. Foren. Kbh.* **110**, 56–57, figs. 6 a–c.
Euchromadora mortenseni, Wieser, 1954. *Acta Univ. lund. N.F.* **50** (16), 103.

TYPE LOCALITY : Tobago, West Indies.

GEOGRAPHICAL DISTRIBUTION. Tobago, West Indies (Allgén, 1947).

In spite of a very large number of specimens Allgén's description of this species is totally inadequate and it can only be considered a species dubia.

***Euchromadora parafricana* Gerlach, 1958**

Euchromadora parafricana Gerlach, 1958. *Kieler Meeresforsch.* **14**, 245–246, pl. 41, figs. 4 a–f.

TYPE LOCALITY : Insel Sarso, Red Sea.

GEOGRAPHICAL DISTRIBUTION. Red Sea (Gerlach, 1958).

This species is very distinct in the form of the punctuation pattern of the cuticle, particularly on the head region. The usual small anterior punctations are not followed by large blocks as in other species. Instead posterior to them are five rows of oval-shaped punctations, then five rows of circular, and then a more typical pattern of large blocks continues over the remainder of the body.

***Euchromadora permutabilis* Wieser, 1954**

Euchromadora permutabilis Wieser, 1954. *Acta Univ. lund. N.F.* **50** (16), 104–105, figs. 153 a–f

TYPE LOCALITY : Coast of Chile.

GEOGRAPHICAL DISTRIBUTION. Coast of Chile (Wieser, 1954).

This is a fairly large species, the females attaining a length of 3.14 mm. and the males 2.98 mm. The spicules and gubernaculum are similar in shape to *E. striata* but are much longer (104 μ –133 μ). The lateral pieces of the gubernaculum are just a little more than half the length of the spicules. In head and general form it is also similar to *E. striata*, but the tail is much shorter.

***Euchromadora stateni* Allgén, 1930 species dubia**

Euchromadora stateni Allgén, 1930. *Zool. Anz.* **90**, 32-34, figs. 4 a-b.

TYPE LOCALITY : I. de los Estadod (Staten I.) off Tierra del Fuego, South America.

GEOGRAPHICAL DISTRIBUTION. Tierra del Fuego Archipelago, South America (Allgén, 1930).

This species is based on one immature specimen only and is unlikely to be recognized from the poor description. This species must therefore be regarded as a species dubia.

***Euchromadora tokiokai* Wieser, 1955**

Euchromadora tokiokai Wieser, 1955. *Publ. Seto mar. biol. Lab.* **4**, 173, figs. 8 a-c.

TYPE LOCALITY : Below the Seto Marine Biological Laboratory, Shirahama-tyô, Wakayama-ken, South of Osaka, on the western coast of Kii Peninsula, near Sionomisaki, Japan.

GEOGRAPHICAL DISTRIBUTION. Western coast of Kii Peninsula, Japan (Wieser, 1955) ; Red Sea (Gerlach, 1958).

This species is very similar to *E. gaulica*, but differs from it in the greater length of the gubernaculum and in the shorter tail. In this species the lateral pieces of the gubernaculum are about 75 per cent of the spicules.

***Euchromadora tridentata* Allgén, 1929 species dubia**

Euchromadora tridentata Allgén, 1929. *Capita zool.* **2** (8), 35, figs. 11 a-c.
nec *Euchromadora tridentata* of Wieser, 1951 (= *E. gaulica* Inglis, 1962).

TYPE LOCALITY : Kristineberg, west coast of Sweden.

GEOGRAPHICAL DISTRIBUTION. West coast of Sweden (Allgén, 1929).

This species is based only on one immature specimen. Schuurmans Stekhoven (1935) suggests that it may be the larva of *E. vulgaris* or *E. loricata*. However, as this cannot be established with certainty it is better treated as a species dubia.

***Euchromadora tyrrhenica* Brunetti, 1952**

= *E. adriatica* (v. Daday, 1901) (see page 177).

LIST OF SPECIES OF *EUCHROMADORA* CONSIDERED VALID

E. vulgaris (Bastian, 1865) de Man, 1886 [Type species].

E. adriatica (v. Daday, 1901) Brunetti, 1952

E. amokurae (Ditlevsen, 1921) Allgén, 1929.

E. archaica Steiner and Hoeppli, 1926.

E. chitwoodi nom. nov. [= *E. striata* of Chitwood, 1951].

- E. gaulica* Inglis, 1962.
E. inflatispiculum Schuurmans Stekhoven, 1943.
E. loricata (Steiner, 1916) Steiner, 1918.
E. mediterranea Allgén, 1942.
E. parafricana Gerlach, 1958
E. permutabilis Wieser, 1954.
E. scampae sp. nov.
E. shirleyae sp. nov.
E. striata (Eberth, 1863) Filipjev, 1918.
E. tokiokai Wieser, 1955.

LIST OF NOMENCLATORIAL CHANGES PROPOSED

- E. denticulata* Cobb, 1914=species dubia.
E. dubia Steiner, 1918=species dubia.
E. elegans Allgén, 1947=species dubia.
E. eumecea Steiner, 1918=species dubia.
E. (Odontocricus) hupferi Steiner, 1918=species inquirenda.
E. kryptospiculum (Allgén, 1942) Allgén, 1951=species dubia.
E. linstowi Allgén, 1959=species dubia.
E. loricata of Allgén, 1927 ; 1947a ; 1951b ; 1959=species dubiae.
E. loricata of Wieser, 1954=*E. archaica* Steiner & Hoeppli, 1926.
E. lüderitzi Steiner, 1918=species dubia.
E. meridiana Cobb, 1914=species dubia.
E. mortenseni (Allgén, 1947) Wieser, 1954=species dubia.
E. stateni Allgén, 1930=species dubia.
E. striata of Chitwood, 1951=*E. chitwoodi* nom. nov.
E. tridentata Allgén, 1929=species dubia.
E. tridentata of Wieser, 1951=*E. gaulica* Inglis, 1962.
E. tyrrhenica Brunetti, 1952=*E. adriatica* (v.Daday, 1901) Brunetti, 1952.
E. vulgaris of Allgén, 1947 ; 1947a ; 1951b ; 1959=species dubiae.

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REFERENCES

- ALLGÉN, C. A. 1927. Freilebende marine Nematoden von der Küste Tasmaniens. *Zool. Anz.* **73** : 193-217.
- 1928. Freilebende marine Nematoden von den Campbell- und Staten-inseln. *Nyt. Mag. Naturv.* **66** : 249-309.
- 1929. Freilebende marine Nematoden aus den Umgebungen der staatlichen Zoologische Station Kristineberg an der Westküste Schwedens. *Capita zool.* **2** (8) : 1-54.
- 1929a. Über einige antarktische freilebende marine Nematoden. *Zool. Anz.* **84** : 126-140.
- 1929b. Neue freilebende marine Nematoden von der Westküste Schwedens. *Zool. Jb. (Syst. etc.)* **57** : 431-496.
- 1930. Freilebende marine Nematoden von der Stateninsel (Feuerland-Archipel) II. *Zool. Anz.* **90** : 27-38.
- 1940. Weitere freilebende Nematoden insbesondere aus dem Schalensand- und Kiesboden der Strandzone Norwegens. *Folia zool. hydrobiol. Riga* **10** : 487-508.
- 1941. Ueber einige freilebende Nematoden aus Brandirna an der Nordküste Kleinasiens (Marmarameer Türkei). *Zool. Anz.* **135** : 281-294.
- 1942. Die freilebenden Nematoden des Mittelmeeres. Eine Zusammenstellung sämtlicher aus dem Mittelmeer bekannten Nematoden. *Zool. Jb. (Syst. etc.)* **76** : 1-102.
- 1943. Norwegische marine Nematoden. *Zool. Jb. (Syst. etc.)* **76** : 267-322.
- 1946. Letzter Bericht über freilebende marine Nematoden aus dem Schalensand und Kiesboden der Westküste Norwegens. *Ark. Zool.* **37A** : 1-26.
- 1947. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. lxxiv. On some free-living Nematodes from Tobago (Br. W.I.). *Vidensk. Medd. dansk. naturh. Foren. Kbh.* **110** : 45-63.
- 1947a. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. lxxv. West American Nematodes. *Vidensk. Medd. dansk. naturh. Foren. Kbh.* **110** : 65-219.
- 1951. Westschwedische marine litorale und terrestrische Nematoden. *Ark. Zool. (Ser. 2)* **1** : 301-344.
- 1951a. Weitere Beiträge zur Kenntnis der Nematoden-Fauna des Trondheim-sfjords. *Zool. Jb. (Syst. etc.)* **80** : 1-26.
- 1951b. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. lxxvi. Pacific Free-living Marine Nematodes. *Vidensk. Medd. dansk. naturh. Foren. Kbh.* **113** : 263-411.
- 1953. Revision der freilebenden marinen Nematoden aus der Umgebung der Staatlichen Zoologischen Station Kristineberg an der westküste Schwedens. *Zool. Jb. (Syst. etc.)* **81** : 548-603.
- 1959. *Freeliving Marine Nematodes. Further Zoological Results of the Swedish Antarctic Expedition 1901-1903.* Stockholm. 293 pp.
- BASTIAN, C. H. 1865. Monograph of the Anguillulidae or Free Nematoids, Marine, Land, and Fresh-water ; with descriptions of 100 new species. *Trans. Linn. Soc. Lond.* **25** : 73-184.
- BRUNETTI, B. 1952. Osservazioni su alcune specie del genere *Euchromadora* de Man, 1886 (Nematoda-Chromadoridae). *Monit. zool. ital.* **59** : 73-81.
- CHITWOOD, B. G. 1951. North American Marine Nematodes. *Texas J. Sci.* **3** : 617-672.
- COBB, N. A. 1914. Antarctic marine free-living nematodes. *Contr. Sci. Nematology* **1** : 3-33.
- DADAY, E. VON. 1901. Freilebende Nematoden aus dem Quarnero. *Természetr. Füzet.* **24** : 433-457.
- DITLEVSEN, H. 1919. Marine freeliving Nematodes from Danish waters. *Vidensk. Medd. dansk. naturh. Foren. Kbh.* **70** : 147-214.
- 1921. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-6. III. Marine free-living Nematodes from the Auckland and Campbell Islands. *Vidensk. Medd. dansk. naturh. Foren. Kbh.* **73** : 1-32.
- 1923. Sur quelques Nematodes libres (Côtes de Bretagne et Rockall). *Bull. Soc. zool. Fr.* **48** : 178-203.

- DITLEVSEN, H. 1930. Marine freeliving Nematodes from New Zealand. *Vidensk. Medd. dansk. naturh. Foren. Kbh.* **87** : 201-242.
- EBERTH, C. J. 1863. *Untersuchungen über Nematoden*. Leipzig. 77 pp.
- FILIPJEV, I. N. 1918. [Freeliving nematodes from the region of Sevastopol I] *Trav. Lab. Zool. Sebastopol* **2** (4) : 1-350. [In Russian.]
- 1934. The classification of the freeliving nematodes and their relation to the parasitic nematodes. *Smithsonian misc. Coll.* **89** (6) : 1-63.
- GERLACH, S. A. 1953. Die Biozönotische Gliederung der Nematoden fauna an den Deutschen Küsten. *Z. Morph. Ökol. Tiere* **41** : 411-512.
- 1953a. Freilebende Marine Nematoden aus dem Küstengrundwasser und dem Brackwasser der Chilenischen Küste. *Acta Univ. Lund. N.F.* **49** (10) : 1-37.
- 1954. Die freilebenden Nematoden der schleswig-holsteinischen Küsten. *Schr. naturw. Ver. Schl.-Holst.* **27** : 44-69.
- 1958. Freilebende Nematoden von dem Korallenriffen des Roten Meeres. *Kieler Meeresforsch.* **14** : 241-246.
- INGLIS, W. G. 1962. Marine nematodes from Banyuls-sur-Mer : with a review of the genus *Eurystomina*. *Bull. Brit. Mus. nat. Hist. (Zoology)* **8** (5) : 209-283.
- 1964. The marine Enoplida (Nematoda) : a comparative study of the head. *Bull. Brit. Mus. nat. Hist. (Zoology)* **11** (4) : 263-376.
- 1964a. The structure of the nematode cuticle. *Proc. zool. Soc. Lond.* **143** (3) : (in press.)
- LINSTOW, O. v. 1892. Helminthen von Süd-Georgien. Nash der Ausbeute de Deutschen Station von 1882-1883. *Mitt. naturh. Mus. Hamburg* **9** : 59-77.
- 1908. Helminthes, Nematoden und Acanthocephala. *Denkschr. med.-naturw. Ges. Jena* **13** : 19-28.
- MAGHRABY, A. M. and PERKINS, E. J. 1956. Additions to the marine fauna of Whitstable. *Ann. Mag. nat. Hist.* (12) **9** : 481-496.
- DE MAN, J. G. 1886. *Anatomische untersuchungen über freilebende Nordsee-nematoden*. Leipzig. 82 pp.
- 1907. Sur quelques espèces nouvelles ou peu connues de Nematodes libres vivant sur les côtes de la Zélande. *Tijdschr. ned. dierk. Ver.* **10** : 227-243.
- 1907a. Sur quelques especès nouvelles ou connues de Nematodes libres habitant les côtes de la Zélande. *Mém. Soc. zool. Fr.* **20** : 33-90.
- MICOLETZKY, H. 1924. Letzter Bericht über freilebende Nematoden aus Suez. *S.B. Akad. Wiss. Wien* **133** : 137-179.
- SCHUURMANS STEKHOVEN, J. H., JR. 1935. Nematoda errantia. *Tierw. N. -u.Ostsee*, **5**, b, 173 pp. (Lief. 28).
- 1942. Nematoden und Austern. *Zool. Anz.* **137** : 181-185.
- 1943. Freilebende marine Nematoden des Mittelmeeres. IV. Freilebende marine Nematoden des Fischereigründe bei Alexandrien. *Zool. Jb. (Syst. etc.)* **76** : 323-380.
- 1950. The Freeliving Nemas of the Mediterranean I. The Bay of Villefranche. *Mém. Inst. Sci. nat. Belg.* (2 ième Ser.), **37** : 1-220.
- SOUTHERN, R. 1914. Nematelmia, Kinorhyncha and Chaetognatha. *Proc. R. Irish Acad.* **31** (Clare Island Survey. Part 54, 80 pp.).
- STEINER, G. 1916. Freilebende Nematoden aus der Barentssee. *Zool. Jb. (Syst. etc.)* **39** : 511-664.
- 1918. Neue und wenig bekannte Nematoden von der Westküste Afrikas. *Zool. Anz.* **50** : 5-19.
- STEINER, G. & HOEPLI, R. 1926. Studies on the Exoskeleton of some Japanese marine Nemas. *Arch. Schiffs-u. Tropenhyg.* **30** : 547-576.
- WIESER, W. 1951. Untersuchungen über die algenbewohnende Mikrofauna mariner Hartböden. I. Zur Oekologie und Systematik der Nematodenfauna von Plymouth. *Öst. zool. Z.* **3** : 425-480.

- WIESER, W. 1952. Investigations on the microfauna inhabiting seaweeds on rocky coasts. VI. Studies on the vertical distribution of the fauna inhabiting seaweeds below the Plymouth Laboratory. *J. Mar. biol. Ass. U.K.* **31** : 145-174.
- 1954. Free-living Marine Nematodes. II. Chromadoroidea. Reports of the Lund University Chile Expedition 1943-49, 17. *Acta Univ. lund.* N.F. **50** (16) : 1-148.
- 1954a. Untersuchungen über die algenbewohnende Mikrofauna mariner Hartböden. III. Zur Systematik der freilebenden Nematoden des Mittelmeeres. *Hydrobiologia* **6** : 144-217.
- 1955. A Collection of Marine Nematodes from Japan. *Publ. Seto mar. biol. Lab.* **4** : 159-181. (Article 15).
- 1960. Algenbewohnende Nematoden aus Rovinj (Istrien). *Zool. Anz.* **164** : 82-88.

